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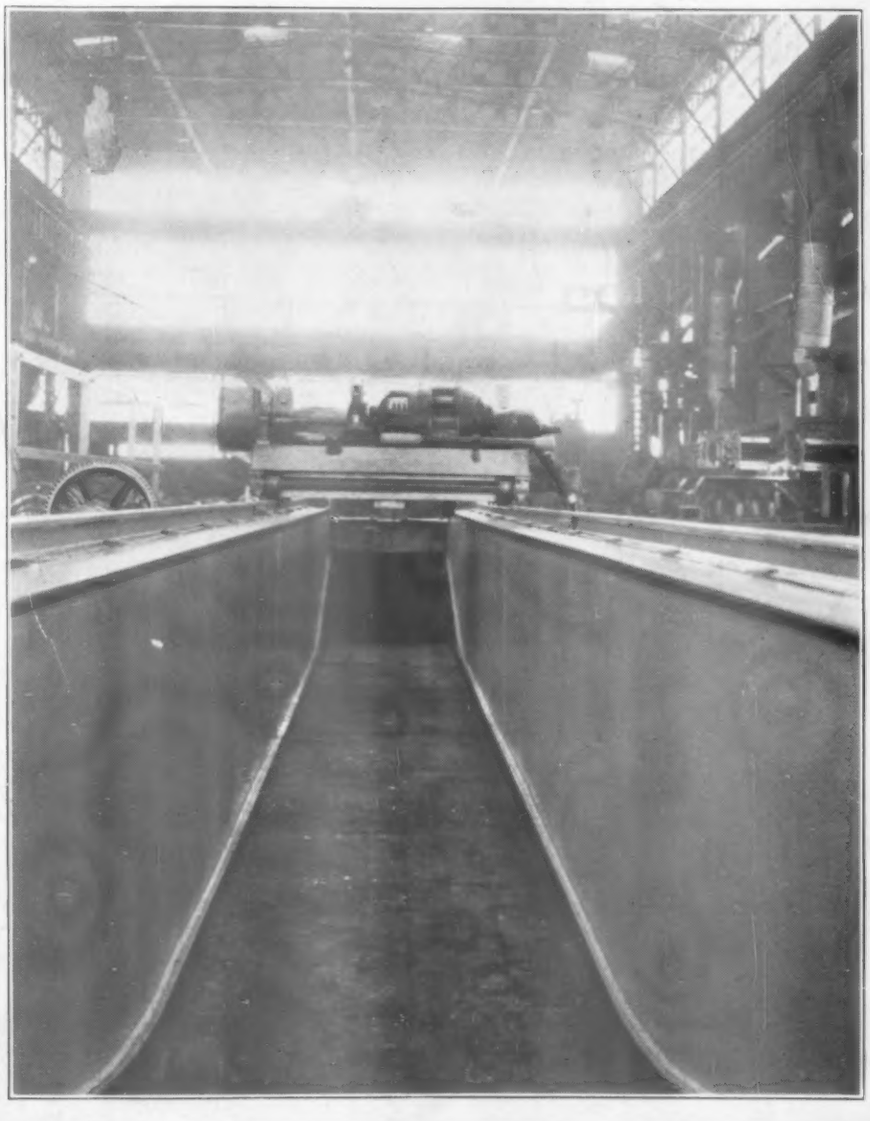
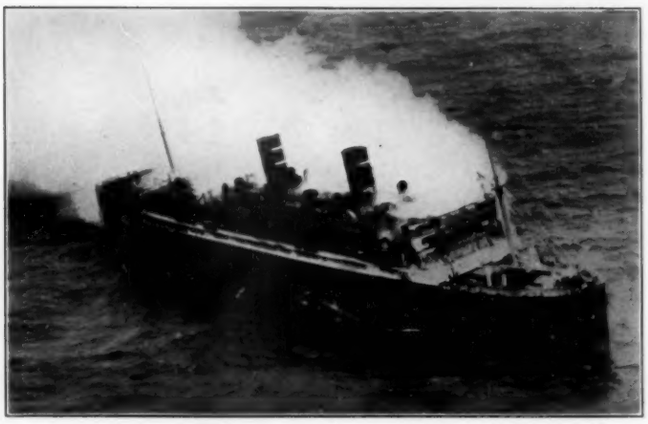
June, 1935 Number 6



neer Business and Technical Journal of the Welding Industry

HARRIS "CITY GAS" TORCHES
TO CUT UP ABANDONED
"MORRO CASTLE"



The $5,000,000 Morro Castle has been abandoned by her owners and underwriters, being condemned by the Navy as unfit for use. The Ward liner was taken by the Army as a menace to navigation and sold to Union Shipbuilding Company of Baltimore, the highest bidder.

The above fact was published in the April 8th issue of "Time" magazine.

● *FLASH* To users of Cutting Torches—the Union Shipbuilding Company, one of the largest scrapping institutions in the world, own 250 Harris Torches and can scrap an 8000 ton ship complete in "Five Days".

USE OF "CITY GAS" AND "HARRIS TORCHES" MAKES POSSIBLE AN

88% FUEL SAVING
12% OXYGEN SAVING
5% INCREASED SPEED

Union Shipbuilding Company will realize the above savings because of their standardization on "Harris" City Gas Cutting Torches exclusively. The above selection and standardization followed SIX MONTHS of unbiased, intensive test and investigation made by "Independent Engineers" employed by Union Shipbuilding Co. for the purpose. Harris was selected from 6 standard makes as the only City Gas Torch superior to acetylene.

According to the Record (see "Gas Age Record," June 13, 1931) or ("Industrial Gases", August 1931) they will reduce this great ship to scrap in terms of 100 sq. inches of metal displaced with the following Gas consumption.

COMPARISON CHART

Harris No. 75 Torch . . . 43.7 cu. ft. oxygen—14.39 cu. ft. City Gas at an average speed of 402 inches per hour.
Acetylene Torches previously used . . . 49.7 cu. ft. oxygen—8.4 cu. ft. acetylene at an average speed of 380 inches per hour.
Saving . . . 12% oxygen—88% Fuel Gas—Speed increase 5%.

● UNION SHIPBUILDING CO. *have ABANDONED the use of ACETYLENE for all cutting*

● Many steel mills, shipyards, etc., as well as "one torch shops" are SAVING MONEY and DOING A BETTER JOB with "Harris" City Gas Torches. There are thousands of members in the "Harris Family."

DISTRIBUTORS IN ALL PRINCIPAL INDUSTRIAL CENTERS CAN FURNISH FURTHER DETAILS

THE HARRIS CALORIFIC CO.
CLEVELAND, OHIO
Oldest Gas Welding and Cutting Apparatus Company in U. S. A.

MEMBER AUDIT BUREAU OF CIRCULATIONS

THE WELDING ENGINEER

MAIN CONTENTS OF THIS ISSUE

JUNE, 1935

Vol. 20, No. 6

Qualification Tests (Page 19)
"Passing the Test" (Peters)

Early Uses of Oxyacetylene (Page 22)
An Early History of Oxyacetylene Welding and Cutting in the United States (Weirs)

X-Ray Inspection (Page 26)
Inspection of Welds, With Particular Reference to Radiography (Isenburger)

Shop Location (Page 28)
Good Location—The First Essential of a Successful Welding Shop (Brockson)

Trucks and Trailers (Page 30)
All-Welded Truck Bodies and Trailers

Arc Control (Page 32)
Magnetic Flare and Arc Blow in Welding—II (Notvest)

Editorial—(Page 17)

Six-Pin Crankshafts Made by Welding and Cutting—(Page 20)

Getting Two Profits From One Job—(Page 20)

Cast Gear Electric-Brazed by Novel Method—(Page 21)

Telegrams Collect Money Faster—(Page 24)

California School Buildings Made Safe Against 'Quakes—(Page 25)

Install Signs on Track Structure by Welding—(Page 36)

Unique Portable Acetylene Welding Outfit—(Page 36)

Get "H. O. T." on Welding—(Page 37)

A Welding Engineer's Wife Speaks Her Mind—(Page 38)

Trade Literature—(Page 39)

Commercial News—(Page 39)

Notes From the Field—(Page 40)

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Pioneers in Equipment for Using and Controlling High Pressure Gases

INDEX TO ADVERTISERS

	PAGE
A	
Adams Co., J. D.	43
Air Reduction Sales Co.	16
Aladdin Rod & Flux Mfg. Co.	46
American Brass Co.	41
American Manganese Steel Co.	13
American Steel & Wire Co.	9
Anti-Borax Compound Co.	46
Arcos, Inc.	50
B	
Bastian Blessing Co., The	6
C	
Central Steel & Wire Co.	43
Champion Rivet Co.	50
Chicago Hardware Foundry Co.	47
Churchward Engineering Co.	Outside Back Cover
D	
Dallett Co., The	46
Dandee Co., The	50
E	
Equipment Manufacturing Inc.	45
F	
Faulk, F. R.	46
G	
Gordon & Gotch	50
H	
Handy & Harman	14
Harnischfeger Corporation	11
Harris Calorific Co.	Inside Front Cover
Hobart Brothers	3
I	
Ideal Face Shield Co., The	50
Illinois Steel Co.	10
Imperial Brass Mfg. Co.	46
International Nickel Co., Inc., The	2
L	
Lincoln Electric Co., The	8
M	
Metal Bond Mfg. Co.	50
Metal & Thermit Corp.	7
Milburn Co., The Alexander	50
Milwaukee School of Engineering	50
N	
National Carbide Sales Co.	46
New Process Plow Welding Co.	50
O	
Owen Electric Mfg. Co.	46
R	
Roebling's, John A., Sons Co.	4
Republic Steel Co.	12
Revere Copper & Brass, Inc.	15
S	
Safety Gas Lighter Co.	46
Seneca Wire & Mfg. Co.	46
Sight Feed Generator Co.	47
Steel Sales Corporation	46
Stoody Co.	Inside Back Cover
T	
Titan Metal Mfg. Co.	Inside Back Cover
Torchweld Equipment Co.	49
U	
U. S. Steel Corp. Subsidiaries	9 and 10
W	
Welding Engineering Co.	46
Willson Products, Inc.	45
Will-Weld Manufacturing Co., Inc.	47

· E D I T O R I A L ·

Some Remarks on the Qualifying of Welders

● Considerable misunderstanding is evident among users of the welding processes with regard to code provisions on qualification tests. Quite frequently some manufacturer or contractor makes an inquiry regarding qualified welders, which is based on the notion that a shop who wishes to do Class 1 vessel welding must go out in the market and obtain welders who have already been qualified for that work. Also, it is not uncommon for welders themselves to inquire how they should go about being qualified for Class 1 or Class 2 work. The impression that welders who have worked on Class 1 or Class 2 vessels carry certificates of qualification, is a mistaken one. This impression has been created from the fact that the A. S. M. E. Unfired Pressure Vessel Code requires that all welders pass certain specified tests in welding before being allowed to work on vessels coming within the jurisdiction of this code. It should be pointed out, however, that such tests are not truly qualification tests. ¶ As a matter of fact, whenever a shop has its welders tested for Class 1 work, even though the tests are satisfactorily passed, the welders can work on code vessels in the particular shop only in which they pass the tests, and then they must be retested every six months, or whenever there is a change in conditions affecting the procedure used. It might be pointed out that a welder passing a test with a certain type and make of electrode, which we will designate electrode "A," cannot work on pressure vessels if he switches to, say, electrode "B," until he has passed corresponding tests with electrode "B." After such tests are successfully passed, the welding operator can work on code vessels of any type in the construction of which the specific tests apply, but only in the shop where the tests were made. In addition to the tests of its welders, the shop engaged in the construction of code vessels must meet certain other requirements as regards testing during and after the vessel is fabricated. If the shop shows its ability to meet all these requirements, it is then qualified for such work. It is, therefore, evident that what is sometimes accepted as qualifying tests for operators are really not such but are a part of the requirements for qualifying the shop itself. ¶ No company insuring vessels under the A. S. M. E. Unfired Pressure Vessel Code has ever issued certificates of qualification to welding operators. It is apparent that the provisions of the code itself would tend to nullify any value that such certificates might have, since the certificates would be of no value whatever to another shop, should the welder change occupation, with the exception that they would indicate a high proficiency on the part of the operator which might make it easier for him to obtain employment in a shop looking for men to pass the code tests. ¶ Users of the welding processes as well as welding operators themselves will find this matter of qualification less confusing if they will keep in mind the fact that the aim of the insurance companies is to qualify the shop and not the welding operators, though the operators are required to pass certain tests as a part of the routine involved in qualifying the shop.

CORRECTION.—The steel specification mentioned in the editorial "When Welding Steel, Know Your Base Metal," in last month's *The Welding Engineer*, should have read "A. S. T. M. A-7" instead of "A. S. T. M. A-5."

It Was a Lively Discussion

● When a group of building commissioners and inspectors enter into a lively discussion on practical aspects of weld inspection and joint design, one may well surmise that municipal authorities are taking seriously the challenge of welding to the older forms of structural-steel fabrication. At a recent meeting in Indianapolis of building officials from many cities throughout the United States, reported elsewhere in this issue, interest was rife, and the chairman cut the discussion short, following a practical talk on structural-steel welding in the nature of a symposium, so the rest of the program might be completed before a late hour. But, with the program finished, the discussion on welding started anew, and the group, on the motion of the deputy commissioner of buildings of Chicago, voted to have a Committee on Welding appointed from among members of the Conference who would report on certain matters at the next Annual Meeting. In view of the close connection of these building officials to municipal law-making bodies, and the influence they can exert on official municipal thought on building construction, through the agency of municipal codes, it would seem prudent and practical on the part of the American Welding Society and its affiliate, the American Bureau of Welding, to invite this committee to be represented at meetings of the Structural Steel Committee and at all hearings for the consideration of codes pertaining to any type of steel structure. In this way, the Building Officials Conference could be kept informed, through their committee, of progress in the formulation of codes and development in design and materials affecting welded structures, and the welding groups in turn could acquire a valuable viewpoint that should be of help in promoting the acceptance of welding by municipal authorities.

I *Cover the* WELDING *Front*

...and find time to GAS awhile!

BY NICK RODDER

MRS. NICK is giving me heck the other night over aint I ever going to stay home long enough to get a few things done around the house, etc. and also I am to remember that not on any account am I to forget that I got to keep June 3 open on account of her brother Ham is getting married. Phew! Right in the middle of the broadcast the phone rings and my other Boss says, "Nick can you hop the Flyer and get out to the Kashaw Company's plant in Toledo. It's a piping job. And if I don't talk any more you can make it."

So I walks into the Kashaw office next morning and find they're looking for me. They've been working with pipe a long time, but mostly steel, and this is their first try with Monel Metal.

So I starts in by showing their two welders how to mix the flux, dissolving it in a half cup of hot water. Then I painted this thin paste flux inside and outside both ends of the tube. It's a butt weld. We started to weld with a very slightly reducing flame. But the boss welder, who was used to using a lot too much heat had to put in a small tip so as to avoid burning the metal and burning holes into the tube. It's only .083-inch thick, being 1½-inch o.d. Monel Metal, and we use 3/32" Monel Gas Welding Rod No. 40, with Inco Gas Welding and Brazing Flux.

Well we made two or three sample welds on the tubing, then cut them out and crushed them in a vise. The first weld wasn't so good, but on the other two, where we had the flame right, boy they *were* good. No sign of fracture in either the weld or the tube.

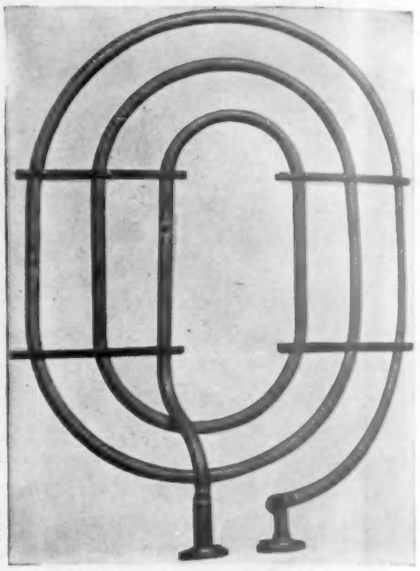
It seemed so easy to make good welds that both the boys started right in, welding the long straight lengths together. After they finished, the benders filled the tubes with sand, and bent them into pancake coils (as above, which see) after which the boss welded on the flanges. Then came the test, 100 pounds water pressure. She held. So did the other two coils. And when I left both boys says, "Nick, that was a lead pipe cinch." "It was easier than that." I shoots back, "It certainly was a Monel Metal tubing cinch." At which they agrees 100 per¢.

✡ ✡ ✡

Well, my next job is on the chain gang. Welding ¾" diameter, hot rolled Monel Metal rod. We used 3/16" No. 43 Silicon Monel Gas Welding Rod.

The fabricator had had lots of experience with sheet metal and plate work in steel, and good background in the gas and electric welding of Monel Metal and Nickel. But he had never welded *any* chain. And that's why I was asked to be there for their first trys.

Our tests were made on straight lengths of hot rolled Monel rod bevelled at the ends to a chisel point. In making the butt joint, this gave us a double vee, each of which had a total included angle of about 75°. The two hot rolled bars were then set up about ⅛ in. apart. The base of the vee was then flowed together with the oxy-acetylene torch prior to adding any filler rod. We were careful to bring the base metal, that is, the edges of the hot rolled bar, up to a fusion temperature so as to get a thorough bond between the filler rod and the hot rolled bar. Each side of the vee was filled up in one operation and normal reinforcement was added on each side. After the few test welds were cooled down, some were bent in a vise in the as-welded condition, and in certain others the welds were ground flush and bent in a vise. In each case it was possible to get at least a 90° bend.



"A lead pipe cinch," declared Nick's buddies when they tu-welded the tubes for this pancake coil... but Nick said, "It certainly **was** *a Monel Metal tubing cinch."*

In addition to these quick free bend tests, other test pieces were made up and pulled in direct tension. They showed up with a minimum tensile strength of 70,000 pounds p.s.i., with the welded joint in the as-welded condition.

From that point on, the welders began turning out chain like a windlass. And that's how I managed to get back in time to see my wife's brother Ham get welded to that pretty little blonde that works in the front office.

Nick Rodder
INCO WELDING SERVICE

INCO WELDING RODS and FLUXES

***for* PURE NICKEL**

Oxy-Acetylene... No. 41 Nickel Gas Welding Wire.
Metallic Arc... INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc... INCO Nickel Carbon Arc Welding Wire No. 21.

***for* MONEL METAL**

Oxy-Acetylene... No. 40 Monel Gas Welding Wire. For flux see * below.
Oxy-Acetylene... No. 43 Silicon Monel Gas Welding Wire.
Metallic Arc... INCO Monel Metal Arc Welding Wire No. 30.
Carbon Arc... INCO Monel Carbon Arc Welding Wire No. 29.

***for* INCONEL**

Oxy-Acetylene... No. 42 Inconel Gas Welding Wire. For flux see ** below.
Metallic Arc... Inconel Metallic Arc Welding Wire No. 32.

***for* NICKEL-CLAD STEEL**

(for welding of Nickel side)

Oxy-Acetylene... No. 41 Nickel Gas Welding Wire.
Metallic Arc... INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc... INCO Nickel Carbon Arc Welding Wire No. 21.

•

FLUXES

*INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

•

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

The Welding Engineer

VOLUME 20 JUNE, 1935 NUMBER 6

"Passing the Test"

Comments on tests and test reports of 200 welders.

■ By ERNEST H. PETERS
Superintendent of Welding,
Southwest Welding & Manufacturing Corp.

SINCE the inauguration and acceptance of electric welding as a practical and favorable method of fabrication, rules, codes, and regulations have been drawn up insuring safety and quality and affecting both the welder and the operation.

Starting with the infancy of electric welding, in the bare-rod stage, with its tensile-strength requirements of 40,000 lb., and elongation practically nil, the various codes have steadily grown more severe, until at present they may well be used as milestones, to gauge the progress and ability of the welding industry.

With the advent of the flux-coated, non-oxidizing electrode, the field for welded construction was vastly enlarged, rising into the highest types of pressure vessels in practical construction. Correspondingly severe requirements were also drawn up by national, state and industrial agencies.

Regardless of a welder's particular type of work, none will excite his interest to quite the same extent as qualifying for a required code classification, or "passing the test." It is at once a test of his skill and a challenge to his ability.

Welders Meet Challenge Offered by A. S. M. E. Code

The A. S. M. E. Code for Unfired Pressure Vessels, with its required 20% elongation on the outside fibers of the weld on a free-bend test, plus 55,000 lb. minimum tensile strength, seemed, at first, somewhat to tax the average welder's efforts.

After a few preliminary figures from the testing laboratory, and possibly the failure of a coupon in one of the three welding positions, he grew more confident. He learned that most of his protection was in the rod itself. A weld, conscientiously made, and passable in neatness, was fairly certain of meeting expectations, without requiring any super-ability or knowledge, aside from obtaining penetration and proper fusion.

Followed by the A. P. I.-A. S. M. E. Code, this was similarly passed with no great exertion.

With the introduction of high-tensile structural steels in building construction, and the relatively high weld-metal strength obtained in their use, a new milestone has been reached by the welder.

The demand for all-welded construction, earthquake-proof buildings—specifically, school-building structures on the Pacific Coast—has again put the welder on the defensive, against the most severe requirements.

The building codes, calling for a minimum of 65,000 lb. tensile strength, and 20% elongation in 2 in., plus a minimum and maximum carbon content, all in positions of flat, vertical and overhead, put the average welder in a position not heretofore encountered. Included in the front ranks of welders to qualify for this class of work, were men considered among the best of their profession.

Some were greatly chagrined at the results. Instead of a healthy margin of 4,000 or 5,000 lb. tensile strength, they either fell below this and exceeded the elongation limits, or their ultimate was exceedingly high but elongation low. Thus the welder was brought to realize that he must have some knowledge of the effect of his technique on the weld.

Most Tests Showed High Ultimate But at Expense of Ductility

The average test ran well into the 75,000-lb. mark or over, but showed around 15% to 18% elongation.

The flat-position tests, contrary to expectations, showed the weakest results. Gases are more easily entrapped in this position, due to the ease of welding with slightly insufficient heat or welding too fast to allow time to break up the gases or release them.

The vertical tests showed much more satisfactory results, owing to the natural procedure requiring more nearly the correct amount of heat in order to obtain penetration into the champfer, and still maintain a good surface appearance. Even though the amperage was reduced, an operator would nevertheless be compelled to concentrate the heat of the arc long enough to obtain the proper back flow of weld metal, consequently reducing the possibility of premature congealing and of subsequent gas or flux pockets. Too great a heat would mean the loss of the weld metal by running off—while in the flat, an excessive amount of heat could unintentionally be used. This could either dilute the weld with too much parent metal, or cause semi-annealing with consequent excessive elongation and thus a sacrifice in tensile strength.

Best Average Tests Obtained Were on Overhead Welds

The overhead-welding test is probably the most surprising to the welder, if he is capable of executing this type of weld. Aside from undisguised poor penetration and fusion, this type of test weld will run up to 85,000 lb. ultimate strength though correspondingly low in elongation. This is plainly due to the welder's inability to overheat the weld through excessive amperage, without losing the molten metal entirely. The ability of some welders to control the weld metal at temperatures higher than others accounts for the increased elasticity obtained, and consequently most overhead tests accomplished by skilled welders show highly successful results, and often pass those welds made in the other two positions.

An x-ray examination of the test coupon, showing minute pin-point gas pock-

ets, rather than denoting a weakness, will most likely prove it to be a weld run at a minimum heat, developing an extremely high ultimate tensile strength.

In the other hand, a negative showing a dense, white, milk-like appearance of the weld, would probably indicate a very good ultimate strength, but with a maximum of elongation.

In the matter of weld-metal analysis, calling usually for a limit in carbon content between 0.12 and 0.18, this may also be considerably altered by the technique used. A normal or proper welding heat will usually give a weld-metal analysis identical in carbon content to the rod used. Too great a heat may easily reduce this content as much as 25% or more.

As these tests increase in severity, the welder is more forcibly impressed with the fact that his knowledge of what is happening during the welding process has an important bearing on the final result.

Kansas to Hold Welding Conference This Month

The first welding conference to be held by the School of Engineering and Architecture, of the University of Kansas, is scheduled for June 27th and 28th. The conference will include day and evening sessions and will be of particular interest to designing engineers, superintendents, foremen, and inspectors of welded structures. The subjects will embrace the design and technique of the fabrication of welded joints. Requests for further information should be addressed to Alfred H. Sluss, professor of mechanical engineering, University of Kansas, Lawrence, Kan. The tentative program follows:

Thursday morning, 9:30—

"Design of Structures for Welding," by A. Vogel, consulting engineer, General Electric Co.
"Reinforcement of Structures by Welding," by Wayne McGlade, assistant county engineer, Wellington, Kan.
"Alternating Current Welding," by W. M. B. Brady, welding engineer, General Electric Co.

Thursday afternoon, 1:30—

"Weld Testing and Qualification of Welders," by F. C. Hutchinson, Linde Air Products Co.
"Magnetic Flare and Arc Blow," by R. Notvest, J. D. Adams Co.
"Pipe Welding to Meet Modern Requirements," by G. F. Dickins, district manager, Air Reduction Sales Co.

Thursday evening, 7:30—

Demonstrations and moving pictures.

Friday morning, 8:30—

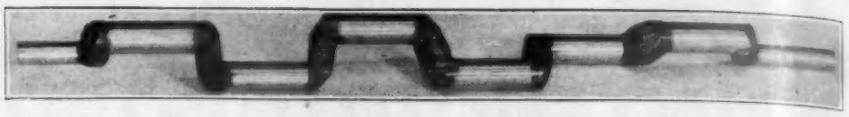
"Steel Fabrication of Machinery," by E. W. P. Smith, consulting engineer, The Lincoln Electric Co.
"Alternating-Current vs. Direct-Current Welding," by V. Max Smith, University of Kansas.

Friday afternoon, 1:30—

"The Shielded Arc," by E. W. P. Smith, consulting engineer, The Lincoln Electric Co.
"Specifications for Welded Structures for the State," by LaMotte Grover, bridge engineer, Kansas State Highway Department.
Demonstration of testing methods by members of the University staff, including use of the x-ray.

Friday evening, 7:30—

"Illustration of Stress Analysis by Means of the Polariscope," by E. W. P. Smith, consulting engineer, The Lincoln Electric Co.



This Welded Crankshaft, Made of Round Nickel Steel, Was Only Five-Thousandths Inch Out of True When Finished.

Six-Pin Crankshafts Made by Welding and Cutting

By HARRY A. GIPFORD
East Ellsworth, Wis.

A few years ago a certain huller was made which required two crankshafts. These crankshafts were made of cast iron, and weighed about 150 lb. each. The wear on them was great, and the result was that they were worn out before the hullers. Owing to the fact that the crankshafts were made of cast iron, it was difficult to rebuild the worn parts and to keep them in true running position. Cast iron did not prove strong enough to stand the shock from the agitators in the huller. Because the company that built these hullers is now out of existence, no more of these crankshafts can be secured.

Some time ago a user of these hullers brought one of the crankshafts to our shop to be repaired. I decided that the only way to bring the machine into use again was to build a new crankshaft. That, however, was a difficult problem, since the shaft had six crank pins. A mold for a new cast-iron crankshaft would have been difficult to secure. Another difficulty was that no two crank pins were set at the same angle, so it was impossible to cut them out of a single block.

Since problems are what we want, and since welding has frequently offered a solution to the most vexing puzzle, I decided that the crankshaft could be made by taking pieces of metal of various sizes and welding them into the shape desired.

The new crankshaft was made out of round nickel steel. The work was done entirely with a cutting torch and an electric welder, and it is an example of what can be constructed by a skilled workman using only these two pieces of equipment. No extra pieces were cut for making the offset for the crank pins. In the making of the crankshaft which is illustrated, no oversize pieces were used for crank pins, though in some of the crankshafts I have constructed, oversize shafting was used for pins.

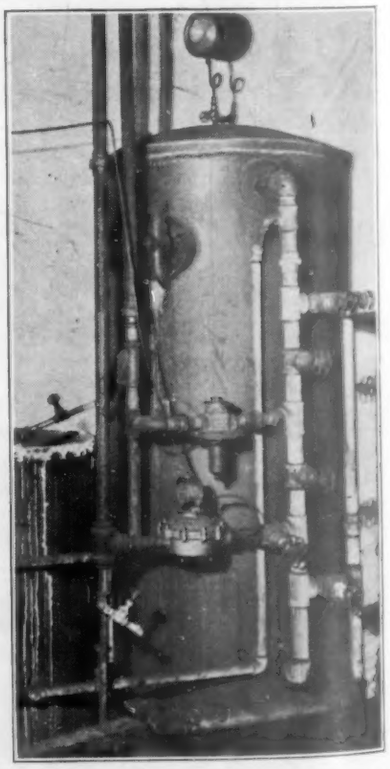
To begin with, I take a shaft long enough to make the full length of the crankshaft and large enough that when I clamp the crank pins in their proper places (before they are tack welded), the shaft will be large enough to form the right amount of offset for the crank-pin throw, or stroke.

These crank pins are then tack welded in place, after which the long shaft is cut out between them with a cutting torch. The short pieces of shaft remaining provide the proper amount of off-set for the crank pins. These pins are then welded solid to the short pieces of shaft. A heavy bead is laid on each side of the crankshaft pin in such a manner as not to draw it out of line. This procedure is continued until enough material is deposited to make up the proper size of reinforcement for the off-set which holds the crank pins.

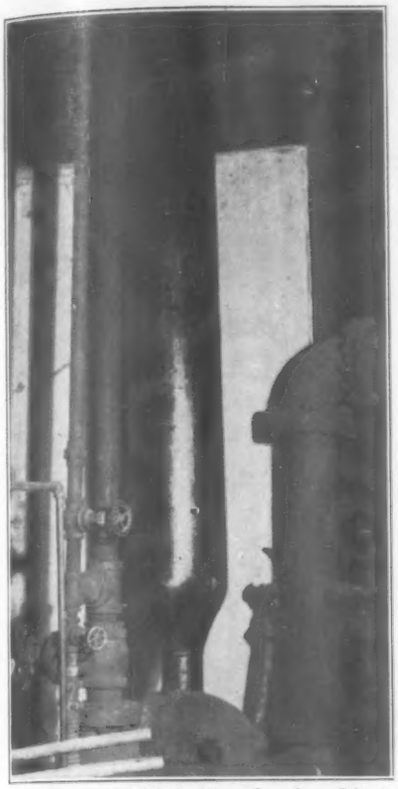
I have built 14 of these crankshafts, and none of them was more than 0.009 in. off true. The crankshaft illustrated was within 0.005 in. of being perfectly true, when completed. No machining is required except for the crankshaft bearings. Also, the use of round stock makes V-ing out for welding unnecessary. Cruciso Simplex 3/16-in. rod was used, with direct current.

Getting Two Profits From One Job

One of the many overworked, and frequently misused, terms of recent years is "Sales Engineering." However, Huffman Bros. & Gavin, enterprising operators of a welding and boiler-work establishment in Bluffton, Ind., recently employed a bit of real "sales engineering" to give a customer some unsolicited service, and by so doing collected the profits from two welding jobs, although they had been called to perform only one.



After Becoming Loose, The Head on This Tank Was Welded Into Place.



This Large Welded Air Chamber Eliminated Pounding in the Water Lines.

They were asked by a local plant whether it was possible to make an arc-welded repair on an industrial water-softener after the convex head had blown loose around the seam. This they did. The job was speedily handled by re-welding the seam and reinforcing it with a band of 2x⅜-in. steel securely welded to both head and barrel, as shown in one of the accompanying views.

This done, they did not feel satisfied to return to their shop until they had determined the exact condition that was responsible for the original blow out.

Persuading the engineer to run the deep-well pump, they observed that there was a terrific impingement in all the water lines near the pump and softener. They called in the plant superintendent, who concurred in their opinion that the pump was operating against insufficient air cushion. He readily agreed to their proposal that they make a larger air chamber, with the understanding that there would be no charge for it if it failed to produce the desired results.

The original air chamber consisted of a 36-in. length of 5-in. pipe with a head welded in the upper end. A new chamber was built, it being 12 in. in diameter, 84 in. long, and constructed entirely by arc welding. The head is of the orange-peel type, made by cutting, forming and welding the end of the cylinder itself. The same method was used in reducing the lower end to 5-in. diameter, to which was welded a 5-in. nipple. A ring welded to the head made it easy to handle and install the new chamber.

The new chamber has more than fulfilled expectations, and the customer now has a better conception of the possibilities of arc-welded repairs, while both jobs brought in approximately $100.

Another thing that proves Huffman Bros. & Gavin to be real "sales engineers" is the fact that they are not secretive about their accomplishments. They realize that an interchange of ideas and experiences among members of the welding craft will serve to promote arc welding in a way that will ultimately benefit all members of the craft. This is evidenced by the following statement in their report to Hobart Brothers, Troy, Ohio, whose arc-welding equipment was used on this job:

"Our experience on this job proves that if the average welder will carefully learn all he can of a job, he can usually create new possibilities in the welding field and consequently make more money for himself."

Cast Gear Electric-Brazed by Novel Method

By using a technique in which Everdur rod is fed into an arc from a steel-sheathed copper electrode, the Superior Welding & Brazing Co., of Detroit, Mich., recently repaired a 1,200-lb. cast-iron gear without preheating. The hub was broken in two, and the rim broken in two places. Extreme accuracy in repairing was required, as this was a precision gear used in a large stamping press, the teeth operating close to the pinion teeth with no appreciable play.

The hub was 9¼ in. long, with an outside diameter of 13½ in. and an inside diameter of 6 in. The diameter of the wheel was 71 in., with a 7-in. face measured across the rim.

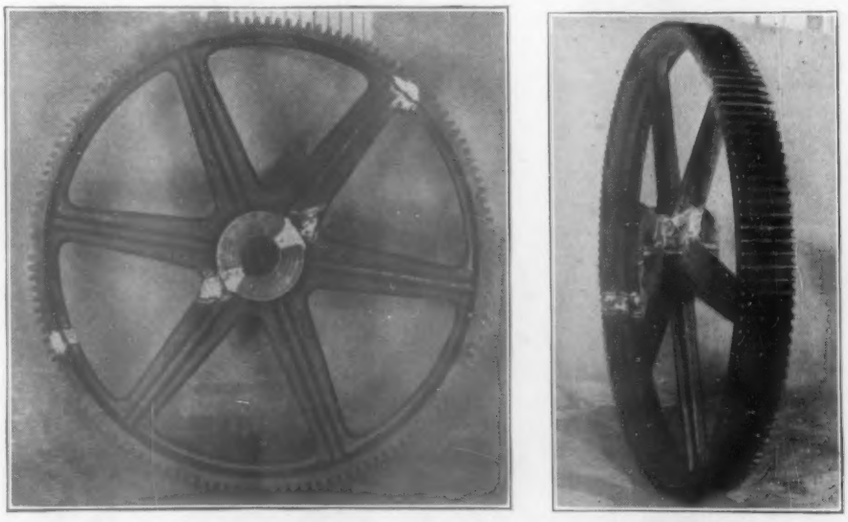
First, the cracks were chipped out to form a V. Then two men welded simultaneously, one on each side of the hub. Starting on the hub, on only one side of the spokes, the welders continued until the rim would start to open unevenly, at which time they would jump to the hub on the other side of the spokes and weld there until the rim was brought back into position. In this way, the gear was kept true and the spokes were maintained in their true plane.

Using "Copper Arc" electrodes, obtained from C. E. Phillips & Co., Detroit, with "Everdur" rods as filler metal, the operators would lay the first bead with "Copper Arc" alone. After peening this layer, all successive beads would be laid by feeding the "Everdur" rod into the arc created by the "Copper Arc" electrode. The "Everdur" acts as a stabilizer and quiets the arc, and it also has a beneficial effect on the deposited metal in that it eliminates any tendency toward porosity.

The job was completed in 14 hours' time, not including the time required for V'ing out the work preliminary to welding. Approximately 52 lb. of "Copper Arc" electrodes and 12 lb. of "Everdur" rod were consumed.

Chicago Section Elects New Officers

Officers for the ensuing year, recently elected by the Chicago Section, American Welding Society, are: Chairman, D. C. Wright, Sears, Roebuck & Co.; vice-chairman, Albert Reichmann, assistant chief engineer, American Bridge Co.; and secretary-treasurer, F. L. Spangler, editor, *The Welding Engineer*. The following were elected as directors for three years: Gale Adams, welding supervisor, Goodman Manufacturing Co.; R. G. Mason, A. T. & S. F. Railroad; R. E. McFarland, engineer, Western Electric Co.; and E. L. Quinn, welding engineer, American Manganese Steel Co. C. J. McGregor, of the American Steel & Wire Co., was elected to represent the Section at the New York meetings of the Society.



Views of 71-In. Cast-Iron Gear After Being Repaired by Welding.

An Early History of Oxyacetylene Welding and Cutting in the United States . . . .

■ By ORN T. WEIRS

WAY back when Packard featured rear-entrance limousines as innovations, oxyacetylene welding was just being born—and so was aviation.

The Wright brothers were building their first engine, having found none suitable for making their glider a propelled machine. Chicago passed a law that motor-vehicle drivers must not wear eye-glasses; and the reputedly first arrest for speeding was made in Minneapolis — 10 miles per hour had been exceeded.

That was in 1902—when Eugene Bournonville, now 73 and formerly vice-president of the Davis-Bournonville Co., became curious about the possibilities of oxyacetylene welding.

He had visited Paris in 1900-01, and had purchased from the French Dissolved Acetylene Co., for the Commercial Acetylene Co. of this country, the process of dissolving acetylene in acetone while compressing it in cylinders filled with a porous material, which, however, happened to be commercially impracticable. So, late in 1901, assisted by the Johns-Manville Co., he invented the asbestos disc-fillers, hardened in sodium silicate to form a non-packing substance.

That was a discovery of revolutionary value, though the older acetylenists will also remember Bournonville as one of the first to exploit acetylene in this country. His automatic generator was one of the first devices of the kind patented, and the first to add the carbide to the water as in present practice, instead of adding water to carbide.

In 1903, Bournonville Demonstrates Fouche's Welding Torch

It is therefore easy to see why, in 1903, he was the one in this country to be confidentially informed about the new process of "melting metals." Edmond Fouche, associated with Charles Picard in developments at the Dissolved Acetylene Co., had sent over a welding torch which Bournonville, in turn, showed to an employee of the city waterworks at Hollis, L. I., N. Y.; and here evidently was the first case of any actual welding done in the United States with an acetylene torch.

The gate of a heavy valve at the waterworks was very porous. Bournonville heated it to a dull red and sprinkled iron chips upon its surface. With the experimental torch he then quickly remedied the defect; and the valve was still in use at the last date of which there is any record. But new developments were received indifferently, skeptically.

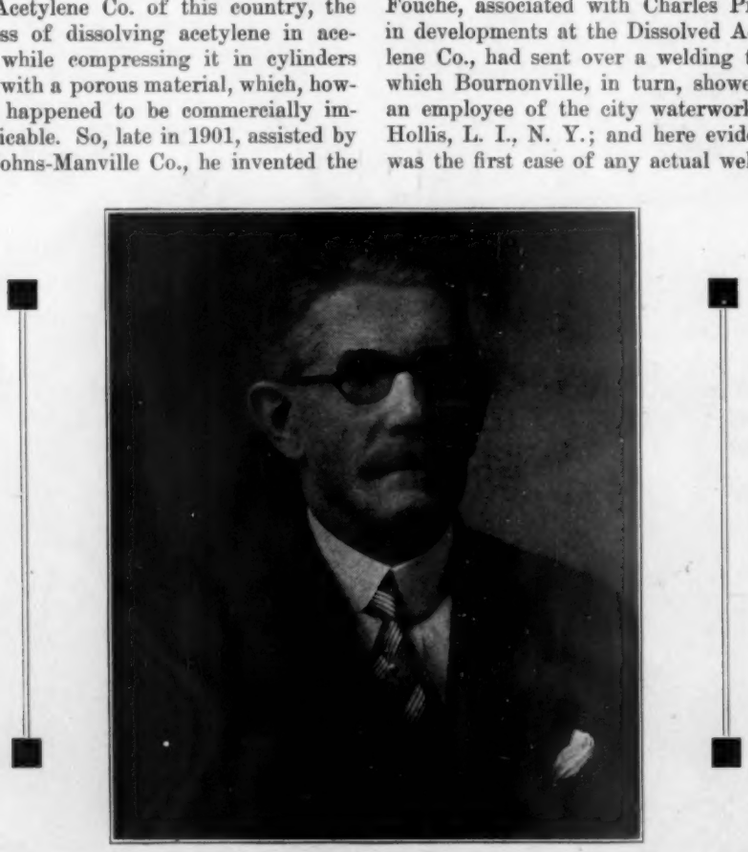
France had produced 16,500 motor cars in the preceding year. Really brilliant racing had started at Daytona Beach. The Wrights were making powered flights. Yet who anticipated the importance of aviation, or the subsequently necessary contributions of welding to it —those marvelous frameworks of light tubing; the intricately welded cylinders for the water-cooled engines; and of course the effect of these designs upon recent engine developments?

Flame Would Burn Life Out of Steel, Said Critics

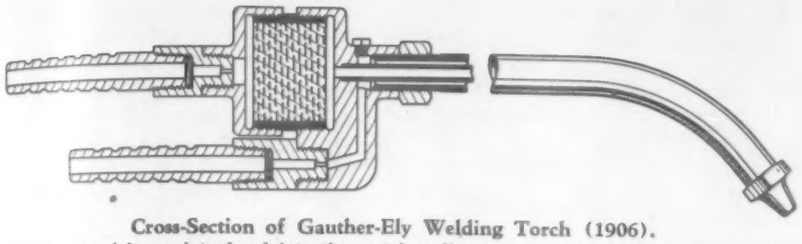
The persistent early objections to oxyacetylene were that "a 6300° F. flame would burn the life out of steel, which melts at less than half that heat," and that "no one but metallurgists or scientists could ever learn to use the torch."

Now, in 1935, we find one of the most important builders of heavy-duty, internal-combustion engines developing a design for strength and lightness that will be made entirely of steel forgings and stampings welded into unit constructions —profiting, obviously, from the enterprise of earlier aircraft engines. Several hundred thousand dollars will be spent for the special welding equipment alone.

In any event, the torches that established the present oxyacetylene industry in this country were brought from France by Messrs. Davis and Bournonville in the spring of 1907—when the first American taxi appeared, and while Ford was erecting his Highland Park plant. That was two years after the appearance of automobile headlights using dissolved acetylene gas under the process also brought here by Bournonville, and the success of



Eugene Bournonville, Who Was Active in the Introduction of Oxyacetylene Welding and Cutting Into the United States.



Cross-Section of Gauther-Ely Welding Torch (1906).

(Porous material was introduced into the acetylene line to prevent flash-backs. The torch was 18 in. overall and was later designed with an oxygen-regulating valve.)

which determined Messrs. Davis and Bournonville to agree in 1906 to introduce into this country the oxyacetylene arts, then very much of a secret.

These first torches were Gauthier-Ely positive-pressure, or medium-pressure types, of Boas, Rodrigues & Co.'s manufacture, these having been found more efficient than either the high- or low-pressure torches first developed.

The accompanying cross-section drawing is of the welding torch, and the photograph shows the actual cutting torch used for the first public oxyacetylene demonstrations in the United States — the first being June 13, 1907, at the Williamsburg Bridge in New York City, where a cut 5 ft. long was made in an iron stringer.

The first order for aluminum welding was completed June 15th of that year.

Amazes Navy Officials by Cutting Port Holes in Armor Plate

Then Bournonville learned that port-holes were being cut in some 2- or 3-in. thick armor plate at the Brooklyn Navy Yard. Two big kerosene torches with nozzles 4 or 5 in. in diameter, each operated by one man, were being used to simultaneously apply heat at the same spot; and when the steel was dull red, three men would chip some of it away by hand. A foreman and five men required 10 days or two weeks to make one 14-in. port-hole.

With a natural surprise, the officer in charge laughed at Bournonville's idea to demonstrate how one man alone could make such holes in less than 30 minutes, yet nevertheless said, "Come—we'll go and see the Admiral."

So Bournonville waited in the anteroom; and the officer, still grinning, was back in just a moment, saying, "Sorry; nothing doing. The Admiral says he has no time to waste with fools."

Since the torch in Bournonville's possession was the same that had been used earlier for similar work at Toulon in demonstrations for the French Navy, he confidently parried the officer's amusement with: "And how about yourself? Would you not like to prove to the Admiral that you weren't endeavoring to introduce a fool?"

The officer walked away. "Naw, it's a daily occurrence around here." Then, a little curious, he stopped to ask, "Well, how could I prove it to him?"

Thus it came about that some armor plate was brought to the Davis-Bournonville shop, where in 1 minute a cut was made 8 in. long. Amazed, the officer had the operation stopped before the plate became two entirely separate pieces, that his Admiral might see indisputable evidence of the story he was to hear.

This Admiral, the late William A. Moffet, 'phoned the next day for an immediate demonstration, at which Bournonville cut a 14-in. port-hole in 12 minutes.

The first sale of apparatus had already been made (September, 1907) to the S. F. Bowser Pump Co., of Fort Wayne, Ind., when the Navy purchased two complete outfits at $5000 each, including acetylene and oxygen generators. The news got around. What was the result?

Railroad Uses Torch in 1907 for Demolishing Station

Demolition of the old Grand Central Station in New York City had started September 1st. Meanwhile, experiments had already developed improvements in the torch tips; and it happened that the first use of these and American torches was late in 1907 by the New York Central Railroad, wrecking the structural steel in their old station, after Bournonville had personally demonstrated 6-days' work accomplished in 6 hours, at what the railroad estimated was one-twentieth the cost of other wrecking methods. This early apparatus for cutting was made with a welding torch, to the side of which had been attached a removable tube for high-pressure oxygen — an arrangement that required three hoses and three cylinders in those days.

Ford's famous Model T car appeared in 1908, at which time a large foundry affiliate of Bethlehem Steel was worrying over their forge shop's slowness in welding several thousand rings for paraffin presses, under a time-limit contract with the Standard Oil Co. Blacksmiths required 10 minutes per weld, which is why the foundry arranged to see a demonstration of the new welding.

Like everyone else at the time, they felt skeptical of so much heat for steel, believing the metal would be burned to slag. Strength, however, was not required of the rings; it was necessary only to close their ends, for which purpose acetylene welding satisfied the foundry's Mr. Bradley, who then became curious—he wished to see some cutting done.

Leaky Hose Results in Severe Burn

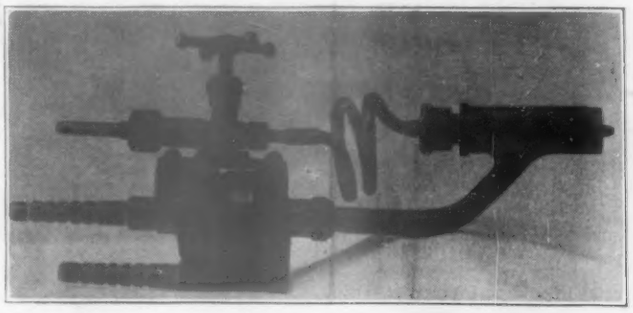
So Bournonville was obliging with a demonstration, when suddenly he threw down his torch, jumped out of his clothes (almost) and shut off the valves—all in one second, or something very close to it, he says, when recalling the accident, which left him an abdominal burn 8 in. in diameter. The cutting was with oxygen at 130 lb.; and a pin-hole leak in the hose, with a spark to ignite it, had burned a ¼-in. hole through his clothing, the flame impinging against his body and spreading in all directions. His shoes partly filled with blood during the remaining half-hour of demonstrations.

But Bradley never knew of this. A new hose was immediately attached. Bournonville kept his linen duster buttoned around himself, and cutting proceeded without further mention of the accident. Thus the foundry was convinced; and they bought two outfits, including generators and six torches that were operated continuously to avoid the penalties of their contract.

The first equipment to be made especially for repairing defects in rough castings was purchased shortly thereafter by the foundry, which later became the Atha unit of the Crucible Steel Co. of America.

Hudson River Tunnel Joined by Welding, in 1909

Following this, the ends of William G. McAdoo's famous tunnels were joined under the Hudson river (May, 1909)—the first notable application (and competition) of oxyacetylene equipment in construction work. Bournonville was asked by the tunnel engineers to demon-



Gauther-Ely Cutting Torch (1906).

(First oxyacetylene cutting torch to be demonstrated in the United States. View shows the tip of the oxygen jet, to one side of which are three small holes for the preheating flames. In all other respects the design is similar to that of the welding torch shown at the top of the page.)

strate oxyacetylene methods, only to be surprised at discovering the first case of bidding from competitive apparatus. Another inventor was seeking favor for a torch and acetylene generator which, unhappily for him, required twice as long to do the work; for it was here that the new interchangeable, injector-type tips first established their efficiency in open competition. Oxygen consumption had been reduced about 30%, to nearly the theoretical consumption for perfect torches.

The next developments were the era of "headaches"—a period when each engineer seeking the benefits of the process disclosed new, difficult and perplexing problems to be solved, especially in connection with relatively large castings. What these all were is known by only a few, because publicity was feared; and those resorting to the new welding were generally misjudged as fakers, trying to patch and hide incompetence.

New Applications Bring Up New Problems

Some cases were interesting but simple, like the first experience with monel metal—a large marine propeller. Three different castings had been failures from center shrinkage and blow holes. The problem was solved by heating a propeller with charcoal fires, after which a torch was used to get the metal plastic around the holes before pouring monel metal into them—giving a repair that machining and closest examination did not disclose.

But the Solvay-Process plant in Syracuse, N. Y., had the most difficult problem, if not the most ambitious repair ever welded by one man. On their scrap pile were 50 cracked, hemispherical salt kettles, perhaps 9 ft. across, weighing approximately 12 tons each, and with walls 3 in. thick. Every other welding process had failed. Bournonville also spent two futile weeks without welding these cracks, some of which were 7 ft. in length.

Then he put a kettle on its side, and, utilizing easily moved grates, installed coke-fires inside that heated it a dull red. Application of the torch gave a weld so completely successful that Solvay immediately bought two complete outfits, including oxygen and acetylene generators.

The Ansonia Copper Co.'s problem is notable not only as the first major job of its kind, but also because its solution and methods of procedure were developed for the first time entirely by long-distance telephone; and, being accomplished over a week-end, prevented a costly shut-down that might have extended over one or two weeks. A gear, approximately 9 ft. in diameter, with a 16-in. face, ran the entire plant. This gear was in two sections and had about 4 teeth per foot. Between two adjacent teeth, where the run was 3 in. thick, a crack had appeared. The first attempt to weld had increased the crack to ⅛ in. wide. A telephone call to Bournonville late on a Saturday night brought the information that the hub should be heated on the same side of the gear prior to making the weld. This advice was followed, resulting in a perfect job, with the adjacent teeth measuring only 1/100 in. too far apart. Normal plant operation was resumed the following Monday.

What appears to be the first American lecture on oxyacetylene methods was given late in 1909 at the Brooklyn Polytechnic Institute; and Mr. Bournonville said of development at that time, "We have the heat all right, but now we must discover how to use it."

It is evident at the Ansonia job how he and his associates were already pioneering with the important ideas of induced expansion, rather than just considering contraction allowances, and sometimes displacements arranged by wedges or other mechanical means.

Two-Hose Cutting Torch Makes Appearance in 1912

The early entrance of the Union Carbide & Carbon Corp. into active and able competition of course beneficially accelerated many new developments (and public interest as well) with an energy naturally impossible in the absence of such stimulus. The application of special regulating valves had already brought out cutting outfits requiring only two cylinders, though three hoses were still necessary. But 1912 marked the entry of the two-hose cutting torch, as well as the introduction of industrial apparatus with various torch-guiding arrangements.

Also, several hundred thousand dollars had already been spent to develop cheap oxygen. So, quite obviously, the demands of the War came as an important sustaining and vitalizing impetus for the young industry, staggering as it was under research expenditures which had precluded dividends as late as 1915, at which time five notable competitors exhibited at the Panama-Pacific International Exposition.

Telegrams Collect Money Faster

By FRED E. KUNKEL

A welder, hard pressed for some ready cash, in sheer desperation sent an urgent appeal by telegraph to a debtor who owed him some money and from whose thick hide dunning letters had fallen like water from a duck's back. He got a check by return mail.

The telegram read: "Am in Urgent Need of Funds—Can You Help Me Out."

This quick result gave him an idea, and now he handles all his hard-to-collect accounts via the telegraph. He found that telegraphic communications were not only time savers, but they almost invariably produced the desired results.

"Telegrams work marvels," he says, "when it comes to collecting overdue coin. My experience has demonstrated that you can raise money on bad debts and quicken your collection turnover from slow-pay customers by using the telegram.

"So whenever I bump into a hard-boiled debtor by mistake, and the customer seems to pay no attention to my earnest pleas for payment, as broadcast in a perfectly good series of collection letters, I get busy and send him a telegram. And it gets results, for it brings up the debtor with a quick jerk, wondering what is going to happen next.

"I follow a regular system. I list all of my slow-pay accounts and make a drive on them regularly every Saturday. I talk with them personally on the telephone first, and this alone produces very good results. I remind them of their bill and they generally promise to come in and settle up, or send a check on a certain day.

"For those who forget their promise I have a surprise in store for them in the form of a telegram.

"The telegraph is also a wonderful *location* medium. If you suspect a possible *skip*, you can send out your telegram and the telegraph company will report back exactly where the telegram was delivered and when."

Welding and Cutting Code for Machinery Construction

A "Tentative Code for Fusion Welding and Flame Cutting in Machinery Construction" has been issued by the American Welding Society, 33 West 39th St., New York, N. Y. This code is intended to cover principally those structures that are substituted for castings. Specifications cover base metal, filler metal, heat-treatment, unit stresses, gas cutting, qualification tests, test results, and workmanship. In the case of rotating parts, reciprocating parts, or parts subjected to severe impact load, heat-treatment in a furnace is specified, and a test report on the material used is required. Tests for qualifying operators include reduced-section tensile tests, nick-break tests, and free-bend tests, two specimens being required for each.

Purdue Freshmen Required to Take Welding Course

The new curriculum of Purdue University, Lafayette, Ind., requires that beginning with the opening of the fall term in September, this year, all freshmen engineers must take one year of the course designated as "Forging—Welding and Heat Treating." The university is expanding the facilities of the shop to meet the need that will be raised by this new requirement, says J. D. Hoffman.

Battledeck Flooring on Grade Separations

Two jobs involving the welding of battledeck flooring on bridges are being completed by the Western Welding & Boiler Repairing Co., 1432 W. Lake St., Chicago, Ill. One of these is on a railroad bridge over the North Ave. highway in Melrose Park, and the other is also a railroad bridge 12 miles out of Elgin, spanning State Route No. 20. The former job involves the plug welding of 2800 11/16-in. holes and the butt welding of the plates, making a water-tight floor. The bridge near Elgin has a ½-in. plate floor, 66 ft. long and 30 ft. wide, and will be welded to obtain watertightness, without interrupting railroad traffic over the bridge.

Plant Supervisor Gives His View of "Welding Experts"

When a welding supervisor of a large plant employing welding on a huge scale recently made the remark that he was an "expert welder," the superintendent of the plant, who has 72 welding operators under him, overheard the remark and promptly wrote out the following impressions on welding, signing his nickname "Smoky":

"The multiplying applications of welding has been progressing so rapidly during the last decade, that the business has developed into an art—the art of welding.

"To be able to speak on this art intelligently, an individual has to have these qualifications:

"(1) Experience in the making of steel in the open hearth; (2) a good education; (3) be a good metallurgist; (4) be a good welder; (5) have wide, practical welding experience; (6) have a wide understanding of expansion and contraction; and (7) be able to say 'Yes' or 'No' when asked if the job can be done, and state why.

"Speaking of different applications, it would be unreasonable for me to expect a man that welds on boiler plate from 16 gauge to 1 in. to be 90% proficient on welding and setting up work on aluminum, alloy steels, cast iron, and several other metals, or vice versa.

"For that reason, to get the best results in every branch of work, the welder should be trained starting on the light plate and kept there until he becomes 90% efficient, or near it, on this particular kind of work.

"The foundry has its qualified operators, as has the boiler shop, tank shop, tractor department, structural-steel department, steel mills, shipyards, railroads, and several other industries, each governed under different codes and qualifications pertaining to their special line of work. It is sometimes amusing to hear of this man or that man being an expert welder. In my opinion, an expert is just an ordinary man away from home."

California School Buildings Made Safe Against 'Quakes

By A. F. DAVIS
The Lincoln Electric Co.

Only the strongest buildings can withstand the destructive force of an earthquake. Unless adequate strength is built into the structure it will totter and fall during extreme seismic disturbances.

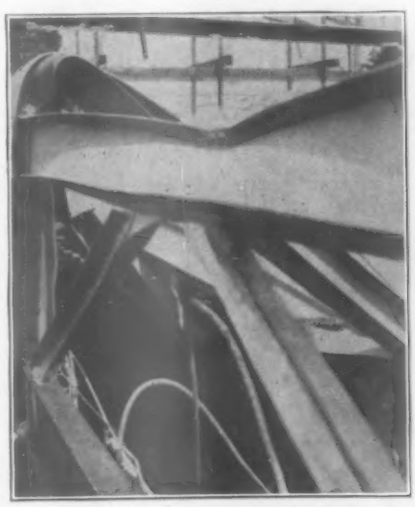
In order to guard against earthquake destruction, the state of California has laws regulating the structural strength of buildings. Development of higher-tensile-strength steels, together with efficient processes for erecting them, has contributed greatly to preventing structural failures caused by tremors in the earth's crust.

Efforts in this direction have not stopped with erection of new buildings. Going further, additional strength has been given existing structures in order that they might resist earthquake shocks.

SCHOOL	LOCATION	COMPANY
El Rodeo	Beverly Hills	Consolidated Steel Corp.
Beverly Vista	Beverly Hills	Consolidated Steel Corp.
Graham	San Pedro	Pacific Iron & Steel Co.
Torrance High	Torrance	Pacific Iron & Steel Co.
Anaheim Union High	Anaheim	Pacific Iron & Steel Co.
Pomona High	Pomona	Pacific Iron & Steel Co.
Woodrow Wilson High	Long Beach	Pennsylvania Iron & Steel Co.
Excelsior Union High	Norwalk	Apex Steel Corp.
State School for Boys	Whittier	National Elec. Welding Corp.
Fine Arts School	Inglewood	National Elec. Welding Corp.
Public Schools	Santa Monica	City of Santa Monica

A great deal of this work has been done on California school buildings. A total of 27 schools, 18 in the San Francisco Bay region and 11 in Southern California, have been strengthened. On all these jobs, the shielded-arc process of welding has been employed.

The welding of the steel framework of these schools required the highest quality of work. Tests were conducted by the National Reemployment Service to obtain highly efficient welding operators. The tensile strength had to be 65,000 lb. per sq. in. and a ductility equivalent to 20% elongation in 2 in.



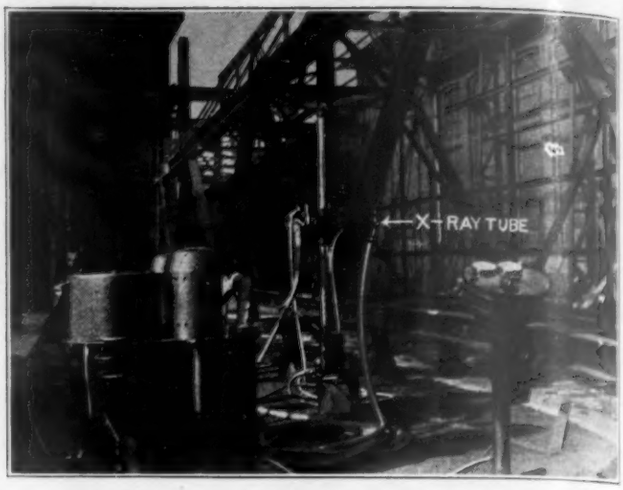
Twisted Framework in Wreckage of the Girl's High School, San Francisco.

Rivet Sheared Off in Wreckage of School Building.

Some of the schools of Southern California and the companies which did the work on them are as follows:

Of the 18 school-strengthening jobs in the San Francisco Bay region, seven were done by the Schrader Iron Works, six by the Fair Manufacturing Co., two by the California Steel Products Co., and three by the Judson Pacific Co. These companies also employed the shielded-arc process of welding.

The Terrific Earthquake Forces Did Not Loosen Any Shielded-Arc Welds.



Portable X-Ray Apparatus Set Up on a Welded Bridge Structure. (Seifert.)

Inspection of Welds . . .

. . . With Particular Reference to Radiography

By HERBERT R. ISENBURGER
St. John X-Ray Service, Inc.

THE particular phase of weld inspection under discussion in this paper is the non-destructive testing of the finished product.

Some inspectors insist that they can tell a sound weld from a poor one by merely looking at the outside of the weld, or by listening to the sound of the arc while the weld is being made. With a great deal of experience, some knowledge undoubtedly can be gained. Such methods, however, are thoroughly unreliable. We have examined numerous welds, perfect in surface appearance which turned out to be very porous. We have also had occasion to examine poor-looking welds which turned out to be perfectly sound inside.

Visual Inspection Does Not Reveal Weld Soundness and Penetration

While a careful visual inspection may be sufficient for most welding jobs, there still remain a great number of applications where the strength of the joint depends upon absolute soundness and complete penetration of the deposited weld metal. Various means have been suggested from time to time to insure this. To mention all of them is impossible here. We have to restrict ourselves to the most commonly used methods. These can be grouped into two classes:

(1) Superficial inspection,

(2) Methods which give positive evidence.

Depending upon the importance of their future service, welded structures can be tested successfully by a sufficiently reliable method falling under either class. In the first class we group the sonic methods, which probably are the oldest forms of non-destructive inspection. Kinzel[1] has suggested the use of a stethoscope for weld testing, similar to the medical application. He recently developed a recording instrument which is said to be more reliable than the human ear.

Some authorities urge the examination of welding rods before and during use. A magnetic analysis[2] by comparison with a standard material enables the inspector to determine the uniformity of the welding rods. In electric-arc welding, uniform performance can be controlled by the Arcronograph, developed by Ronay.[3]

Another kind of inspection method which falls under the first class is the magnetic analysis by the use of a metallic powder.[4] This method sheds some light on the question of internal soundness. The welded zone has first to be magnetized, and a special metallic powder is dusted over it. When it is tapped lightly the powder falls off, unless there is a flaw at or near the surface. Butt welds have thus been examined.[5] For the inspection of welded seams in pressure vessels, an electro-magnetic method has been tried out, whereby the beads must be machined flush with the plate thickness.[6]

None of the methods thus far described yields positive results as to the extent and nature of defects within the weld region or as to their exact location.

Application of Radiography to Weld Inspection Is Quite Recent

Positive results can only be shown, and a permanent record be obtained, by means of radiographic inspection. Because of this essential feature, the methods falling under the second class, which comprises x-ray and gamma-ray examination, are the more desirable for non-destructive weld inspection. These will, therefore, be considered more fully. The principles of both methods are more or less alike and have been described so often that we do not need to go into details here. Gamma-ray inspection is useful where x-ray examination ceases to be practicable. Although some private work had been going on for some time, little information can be found in the technical literature[7] until Pilon,[8] for the first time, addressed a large audience of welders on the subject of x-ray inspection, on July 1, 1921. Numerous articles and papers on this subject periodically report the progress made since then.[9]

Radiographic inspection enables welders to learn more readily to apply the correct technique for various welding jobs, since they can see the inside appearance of their work; special welding procedure can be developed faster through the aid of radiographs and expensive physical tests on welded plates can be

[1] *Journal of The American Welding Society*, vol. 8 (1929), Sept., pp. 71-78; Nov., pp. 48-51. Welding Symposium, American Society for Testing Materials, 1931, pp. 54-58.

[2] *Metal Progress*, vol. 19, No. 6, (1931), pp. 40-44.

[3] *Journal of The American Welding Society*, vol. 12 (1933), May, pp. 22-23.

[4] *The Welding Engineer*, February, 1930, pp. 31-35.

[5] Welding Symposium, American Society for Testing Materials, 1931, pp. 59-72.

[6] *Journal of The American Welding Society*, vol. 9 (1930), Oct., p. 111.

[7] *Transactions*, Faraday Society, vol. 15, part 2, (1920), Feb., p. 28.

[8] Library Acetylene and Autogenous Welding, Paris, 104 Blvd. Clichy.

[9] See bibliography, "Industrial Radiography," by St. John and Isenburger. Chapman & Hall, London; John Wiley & Sons, New York, 1934.

pre-checked by laying out the test coupons on the exograph. If the weld does not show a desirable degree of soundness, time and money can be saved by discarding unfit material. The most valuable service radiography renders is, of course, the final inspection of the finished product. This can be done in the fabricating shop as well as in the field. In some special cases it should also be repeated periodically after the equipment has been in service. Welded fuselage structures in airplanes, and high-pressure, high-temperature equipment in chemical industries, require such inspection. It becomes imperative where human life is at stake.

The electrical apparatus wherewith x-ray inspection is performed must be specially adapted to the nature of the work. Thus a shop unit is built differently from field equipment.

The first consideration, when installing an x-ray machine, should be the safety of the operating personnel; the installation must be x-ray proof and all high-voltage danger eliminated.

The second requirement is economical accomplishment of the inspection. This point has been misused to a great extent by inexpert advisers. The cost of upkeep of an x-ray machine, if properly installed, is practically nil for shop equipment where air-cooled tubes can be employed. Furthermore, the economical use of the apparatus depends upon the efficiency with which the inspection is carried on. This, in turn, depends on a great many factors.

One May Choose Between Two Types of Rectification

Present-day x-ray machines are of two types: Those employing thermionic-valve rectification, and those operating on mechanical rectification.

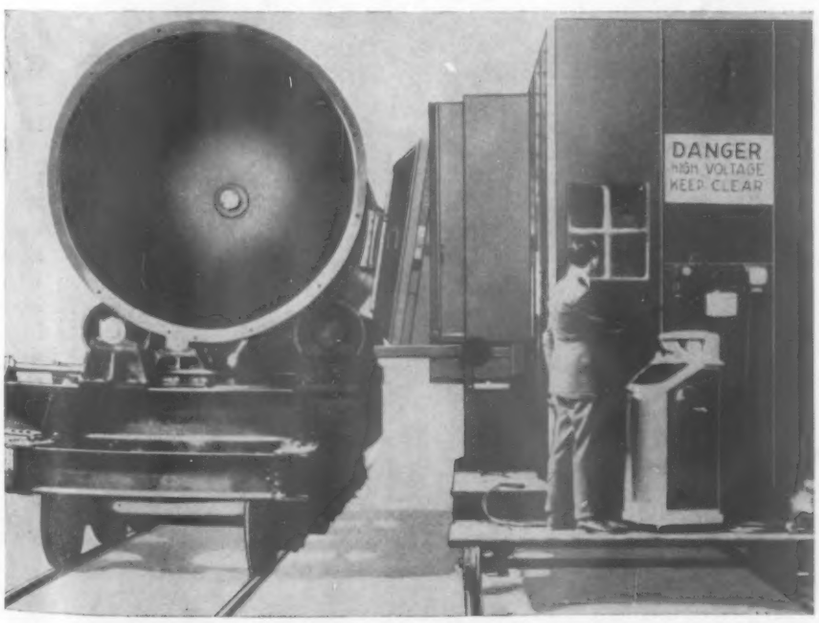
The advantages of vacuum-tube rectification are. (1) Silent operation; (2) no bearings to be oiled; (3) easily adapted to constant-potential outfits. The disadvantages of vacuum-tube rectification are: (1) The uncertain life of the valves, involving replacement and consequent expense; (2) unless condensers are used, both the low non-useful voltage and the high useful voltage are supplied to the x-ray tube; (3) adjustment of the filament current is required from time to time.

The advantages of rotary-switch rectification are: (1) Practically no upkeep cost; (2) very little to get out of order, and adjustment required only infrequently; (3) utilization of high-voltage portion of wave only. The disadvantages of rotary-switch rectification are: (1) Not readily adaptable to portable field equipment; (2) cannot be operated at the high frequency (500 cycles) required for constant-potential direct-current condenser circuits.

How valuable the use of constant-potential circuits may be for routine-weld-inspection apparatus is an open question. The much more important requirement, especially for field inspection, is a compact and rigid unit.

Low-Cost Air-Cooled Tubes Fulfill Many Requirements

A word should be said about x-ray tubes. The author's experience has been mainly with air-cooled tubes. When properly installed, and operated slightly below their maximum ratings, they have given but little trouble. Though their focus is broader than that given by water- or oil-cooled tubes, this does not seem to influence the results. Considering the initial cost of air-cooled tubes, which is almost half that of so-called line-focus tubes, and the fact that the operator does not need to bother with a water- or oil-pumping system, the advantage of the finer focal spot would seem to be negligible. Only for field work, where great flexibility is required, is the use of the more expensive shock-proof x-ray tubes justified. Then, again, we have to be careful in the selection of the high-voltage cables which connect the tube with the generator.



Flexible X-Ray Installation in a Boiler Shop.
(Sun Shipbuilding & Dry Dock Co.)

Routine and Interpretation of Results Are Important

Besides the proper installation for weld inspection, the routine by which this work is carried out, and the correct interpretation of the results, are of paramount importance. Only long experience and thorough knowledge in both x-ray and welding technique will guarantee correct results. This point cannot be emphasized enough. It has been abused frequently by too eager salesmen. Statements by people who may be expert electrical engineers or welding authorities have frequently been accepted as expert opinion on results obtained from x-ray examination. This has done the development of radiographic inspection much more harm than good. As a matter of fact, in such a new and highly specialized field as that of x-ray and gamma-ray inspection of welds, understatements will further the art more than over-enthusiasm.

We have made much progress during the last five years in shop inspection of welded pressure vessels. This work has helped the welding industry just as much as it has assisted the manufacturers of x-ray equipment. Wider use of suitable non-destructive tests will assure greater markets for welding applications. With the perfection of modern welding apparatus and technique, manufacturers are proud to demonstrate the soundness of welded structures, thus removing all doubt from the mind of skeptical buyers.

Welders Meet in Shop to See Demonstrations

Every welder, regardless of how proficient he might be, should try to make his welds just a little bit better, said Edward Walters, of the Wilson Welder & Metals Co., Inc., before a group of welders at the shop of Floyd Young, 741 West 70th St., Chicago, Ill., on the evening of June 4th. Mr. Walters also demonstrated a 75-ampere motor-driven d.c. welder. The group was also addressed by L. C. Monroe, advertising manager, *The Welding Engineer*. These welders, all located on Chicago's south side, hold informal gatherings of this nature each month. W. B. Browning, of The Linde Air Products Co., will address the group on July 2nd.

Good Location—

■ ■ ■ ■ The First Essential of a Successful Welding Shop

■ By W. I. BROCKSON

"George, your shop's not in the right place."

"Maybe it's not, Bill. But I've been here for ten years and always made money before 1930."

"Sure, George, but that's no sign you can prosper here again. We've all got to do a lot of mighty serious thinking about all phases of our business these days, and if anything is wrong we've got to correct it to win. Did you ever realize your location can make or break you?"

* * *

AREN'T there hundreds of men, both those who are operating welding shops now and those planning to establish shops of their own in the near future, who can well take a tip from this chat between two old-timers?

Mediocre equipment and fair craftsmanship in a good location have a greater chance of financial success than the best equipment and master craftsmanship in a poor territory. Location, when once established, is a very difficult thing to change. Consequently, the man who is planning to establish a welding business should give this feature the most careful thought and study in advance. The manager of an old business will perhaps never experience a time when it is both as convenient and as necessary for him to study the possibilities of bettering his location.

It has been the privilege of the writer to come in contact with literally hundreds of job welders, many of them in their own shops. From these numerous conversations has been gathered a wealth of experience data on the question of shop location with relation to its influence on success. A summary of the more important experiences is given here.

One of the most interesting comments on location was made by a shop owner in Indiana, who said: "When a modern grocer starts out to choose a location for a new store he makes a very careful check of the number of people who live in a given district, their average income, habits of buying, competition and other factors. The 'up-and-coming' gasoline station manager tries to 'spot' his stand at the highway junction where the largest number of gas-consuming vehicles pass. Before he actually decides on a site he collects accurate figures on traffic passing several possible locations. When I picked out the location for my shop, I tried to be just as careful as the grocer or the gas-station man in gathering facts. I have been successful here, so I guess that's the 'proof of the pudding'."

Locate Near Industries That Will Use Welding Service

A shop owner in Kentucky explained that in deciding what the possible business is in a given area, an accurate survey should be made of the types of industries existing in the district which can logically be served. Are they the kind which require welding? Are they using welding now? If they can use welding, but do not, what are the chances of selling them on its value? Obviously, a metal-working concern is more likely to be a prospect for a job welding shop than a wood-working company. Also, any manufacturing plant is a far more likely prospect than a mail-order house. A knowledge of the raw materials entering any plant, as well as the finished product going out, will furnish a good insight into the general possibilities for welding.

"If you are picking out a location for a welding shop, study what is going on in the district," said a job welder from Wisconsin. "Is the district improving or going backward as a possible market for welding service? We hear a lot about New England going down as a textile-manufacturing center and the South improving. If we assume that this is true and that these industries were good prospects for welding service, the New England job shop would be likely to have a declining business and the Southern shop an improving one. Almost every territory has one or two important industries, and the job-shop operator should study the probable future of these industries."

"Give me the territory that has some new and growing industries that use welding service," said another shop owner. "If you can get into a territory where there are several establishments in an industry that has a bright future, you have a chance to grow along with these concerns. The automobile business and the radio business are examples of lines that have come up fast in less than a lifetime. In my own case, when I was looking for a location a few years ago, I decided that the airplane-building industry was a comer, so I spotted my shop near what seemed likely to be the center of the industry. The plants in my territory have not grown as fast as the automobile plants did, but they have expanded and I've had more business from them right along."

Naturally, if one is depending upon the growth of a new industry for business, he should not only look into the possibilities of the industry itself but also investigate carefully the likelihood of the local plant being able to keep up with the industry. Also, one should not bank entirely upon certain industries expanding rapidly; there should be other potential business in the district.

"If I had to change the location of my shop," said a Chicago job welder, "I would look in the question of welding equipment maintained and operated by the plants in the territory for their own use. A few years ago I had high hopes of getting a lot of business from three or four of the biggest plants near me. After I called a few times I found out that they all did a lot of welding, but maintained their own machines and operators both for maintenance and production. Of course, the shop operator is always up against competition from company-owned welding apparatus, but the service welder ought to find out as much as he can on this point before he establishes his place of business."

Busy Street or Back Alley —Which?

The question of whether a shop should be located on a prominent street or in some "back alley" was one on which there was a great difference of opinion.

There are several points in favor of locating on a prominent business street. Such a location tends to create confidence in the establishment and is assumed to indicate financial responsibility and technical skill. There is greater advertising value to such a location because of the large number of people passing by. It is easier for prospects to find such a shop and bring work to it. Moreover, there is a greater chance of getting transient business.

On the other hand, there are a large number of successful shops with "back door" locations, far removed from the centers of business. Many are in residential garages or discarded manufacturing plants. Of course, the outstanding advantage about such locations is the fact that expenses are low. Men who op-

erate such shops successfully say that when they first started they went out and called on prospects. They did their first jobs so well, that the customers came back later for more work. In other words, a successful job-shop business depends upon going out after work and pleasing every customer. Under such a program a main-street location may not be so necessary. However, if a shop owner is not willing to follow a policy of aggressive, creative salesmanship, the "out-of-the-way" location is a distinct handicap.

Don't Underestimate Strength of Your Competitors

A shop owner in southwestern Illinois brought out the necessity of looking into competition when deciding on a location. Competition, like the poor, "is always with us." Regardless of how inferior a competitor may be, he gets some work as long as he is in business, and every job he gets is that much less for the new establishment. Don't underestimate how firmly intrenched the old-established shops may be with their trade. It is usually easier for an old shop to hold the patronage of a customer than it is for a new shop to go in and take the business from the old source.

Get as much information as possible about the amount of business competitors are getting and from whom they are getting it. Try to find out how they stand in the estimation of their important customers. Other things being equal, there is a greater chance for a new welding shop succeeding in a given territory if there is only one competitor than if there are three. Of course, the new shop may have far better equipment, more skillful welders and more aggressive sales methods and thereby stand a good chance of outdistancing one or more of the established houses. Nevertheless, this whole matter needs to be given the most serious and thorough-going study before any location is finally selected.

Many Other Factors Affect Cost of Doing Business

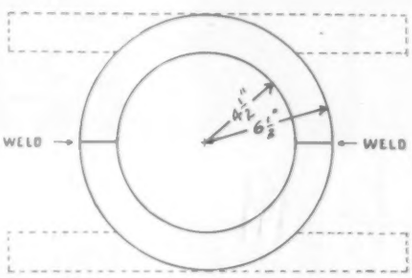
Other factors which should be taken into consideration in locating or re-locating a welding shop are the rent, length of lease available, condition of the building, the suitability of the building for welding work, the lighting conditions, the kind of heat available if any, the cost of electric current, etc. It, of course, requires time and patient effort to gather information such as has been suggested here. However, the fact that job-shop welders have brought out these points is an indication of their practical effect upon the success of a shop. All these things affect the "pocketbook" of the service welder. It is far better to have information about them in advance, than to be adversely influenced by them later.

After the facts suggested have been gathered with regard to several locations, the man starting a new business has only the task of balancing one possibility against another and selecting the one with the most promise. However, the owner of an established business must not only do this, but he must also compare the good-will value of his present location with the uncertain possibilities of the proposed situation. He must choose between something which is known and something comparatively unknown.

In any case, the shop which is located after all of these factors have been considered and weighed has a much better chance to win than the one set up hastily "on a hunch."

Formerly Blanked Out, Large Washers Are Now Welded

A light-gauge circular steel washer, measuring 13 in. on the outside diameter and 9 in. on the inner, is now being made by forming the two halves of the washer from a strip of sheet, 2 in. wide, and then welding the two halves together at their ends, the manufacturer claiming that this method is cheaper than the former



Straight Strips Are Bent, Then Welded.

method of blanking out the parts to shape in a stamping press, since it results in no loss of material.

The former method was to stamp each washer out of a square blank containing 170 sq. in. of metal, leaving about 100 sq. in. of waste metal, only a small part of which could possibly be salvaged.

The washer is now made up of two rectangular strips bent edgewise to form semicircles. These halves are then inserted in a Thomson-Gibb No. 2 welding press, rated at 200 kva., and the ends of the two halves are overlapped ⅛ in. A special fixture holds the parts in place, and the dies bring the ends together, then a heavy current passes through them to bring them up to welding heat, after which sufficient pressure is applied to reduce the welded overlaps to the thickness of the remainder of the washer. The finished washer is almost identical to that produced by the blanking method.

An operator, working with a helper, turns out more than 1000 of these washers per hour. The press is quickly adapted to many different operations merely by changing the fixture.

Program for June Meeting of Los Angeles Section

The following features are announced on the program of the June 20th meeting of the Los Angeles Section, American Welding Society, which will be held on the evening of June 20th:

J. C. Anderson, chief engineer of Unitype Builders, Inc., of Los Angeles, is to talk on "Welded Steel Framing for Residential Construction." Mr. Anderson will describe the welding of the steel frames used on the recently completed *Los Angeles Times* model home, in Hollywood.

A. P. Johnson, of the A. P. Johnson Co., Los Angeles, manufacturers of stainless-steel welding rod, will give a talk on "Practical Considerations for Welding Stainless Steels."

J. S. Johnson, graduate metallurgist of the California Institute of Technology, will talk on "The Relation of Porosity in Weld Metal to Penetration and Back-up Bar Materials."

A motion picture film, entitled "Prosperity Progress," showing the application of acetylene welding in various industries, will be shown through the courtesy of the International Acetylene Association.

12-Mile Water Main to Be Entirely Welded

The laying of one of the longest welded water lines ever installed in Southern California will soon be under way between Slauson Boulevard, in Los Angeles, and San Pedro. The line will be about 12 miles long and will be of 30-in. steel pipe, with all joints welded.

The contract for the fabrication of the pipe for this line has been awarded to the Southwest Welding & Manufacturing Co., of Alhambra, by the Los Angeles Bureau of Light & Power. The project will require approximately 4000 tons of steel, and will cost about $275,000. Special machinery for the fabrication of this large pipe is being installed.

Builds Up Good Business in Welding Valve Seats

A wide reputation in the welding of valve seats has been acquired by C. A. ("Ollie") Fricke, owner of the Sure Weld Electric Welding Co., 2130 E. Larned St., Detroit, Mich. Mr. Fricke not only obtains the work of five cylinder-grinding companies in Detroit, but also receives valve-seat jobs from Ypsilanti, Pontiac, Ann Arbor and other cities in eastern Michigan. His work is so precise that to level it off he needs to remove often not more than 0.004 in. His charge for one valve seat is $7.50; $12.50 for two, and $16.00 for three.

All-Welded Truck Bodies ar

Whether beauty be desired, or strength, or long life, or light weight—, or all four—in these examples welding has offered economies in design and fabrication. All examples shown are from Southern California.

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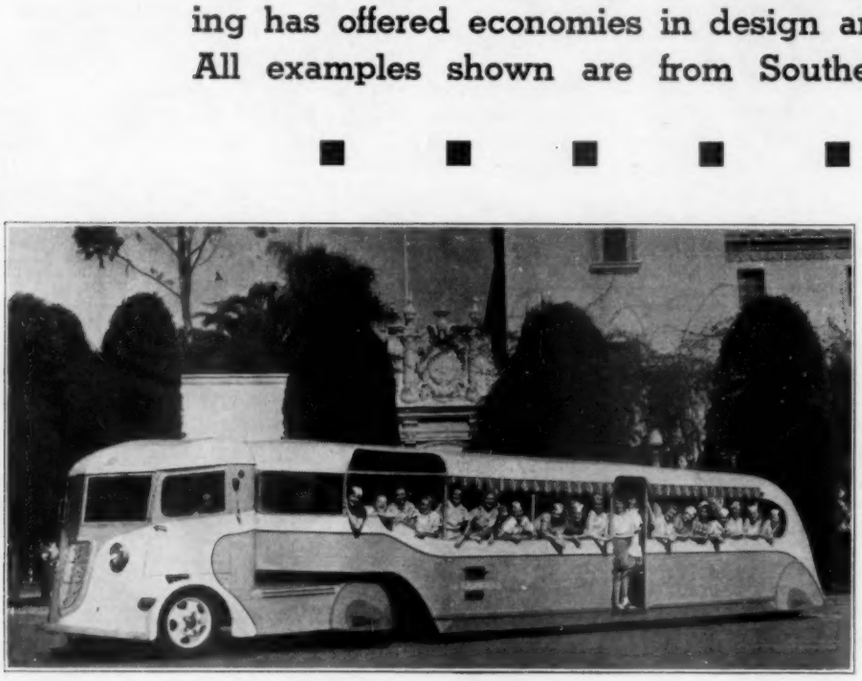
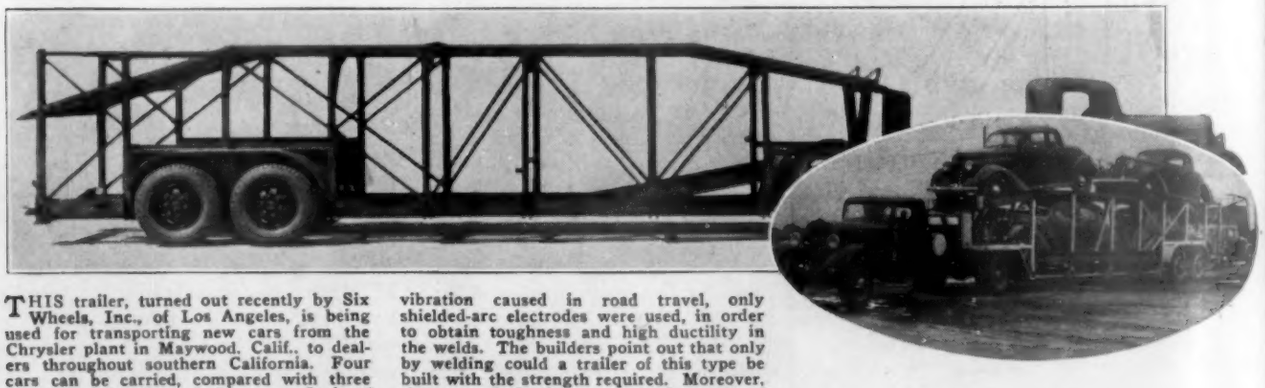


FIVE trailer coaches like the one shown at the left, each 100% welded, are being operated within the grounds of the California Pacific International Exposition, at San Diego. Each has a seating capacity of 40 adults, but with a little crowding, 90 people have been accommodated. It is 45 ft. long and is drawn by a Ford V-8 truck. The cab is directly over the motor. These coaches were built by the Standard Carriage Works, of Los Angeles, and are being operated by the San Diego Railway.

■

A LARGE-CAPACITY portable cement mixer is installed in the 4-wheel semi-trailer shown at the right. The trailer body, which is entirely arc welded, has a capacity of 15 tons. The frame is of I-beams, reinforced in the center at the point of maximum stress with ⅜-in. steel plate. This is a recent job of the Utility Trailer Manufacturing Co., of Los Angeles, which concern changed from the use of rivets to all-welded construction in all of their jobs in 1930, having experimented during five years prior to that time with combinations of rivets and welding. The Utility Trailer engineers state that this same type of trailer with the old type of riveted design weighed 7500 lb., whereas the redesigned job, employing all-welded construction, weighs but 6000 lb. Also, they claim that costs are materially reduced, and that the welded job makes a sturdy, long-life trailer, without the objection of rivets loosening from vibration in travel.



THIS trailer, turned out recently by Six Wheels, Inc., of Los Angeles, is being used for transporting new cars from the Chrysler plant in Maywood, Calif., to dealers throughout southern California. Four cars can be carried, compared with three in the usual trailer of this type. It is of all-steel construction, and 100% electric welded. Owing to the heavy stresses and vibration caused in road travel, only shielded-arc electrodes were used, in order to obtain toughness and high ductility in the welds. The builders point out that only by welding could a trailer of this type be built with the strength required. Moreover, the cost of riveting or any other type of construction would have been prohibitive. The trailer is drawn by a Dodge truck.

railers . . .

. . . in a wide variety of designs and sizes

THE small, sturdy trailer shown below is ideal for making light deliveries, for camping purposes, etc. Its one wheel, which is of small diameter, functions similarly to a caster on a piece of furniture. In an emergency, one man can easily handle its light weight of 160 lb. and quickly attach the trailer to a car. Since the front is rigidly secured at both sides of the rear of the car, the trailer can be easily backed up to a door or any desired spot without difficult maneuvering. It goes straight with the rear of the car—forward or back. The frame and bed are made of steel throughout, and are 100% welded. The bed is of 16-gauge metal and is 4 ft. wide by 5 ft. long. Two 2½-in. channel irons are crossed to make an X-type frame, and are braced and arc welded, providing great strength and durability. The wheel operates on a specially designed swivel and a fork made up of car-spring leaves, the latter aiding materialy in absorbing road shocks.

ABOVE is a large trailer built by the Custom-built Trailer Manufacturing Co., of Los Angeles, for transporting rolls of paper for the Los Angeles daily newspapers. This trailer is 28 ft. long and 8 ft. wide and has a 12-ft. drop type of frame, made of 6-in. ship channel. It is welded throughout, including the solid sheet-steel floor. Though its capacity is rated at 18 tons, it has often hauled as much as 25 tons. Welding made a 25% saving in the cost over riveted construction, and added considerable to the strength, at the same time reducing the weight, according to the manufacturer. This trailer is drawn by a 4-ton Studebaker truck and makes daily trips between Los Angeles and the San Pedro ship docks.

THIS stream-line beer-delivery truck body was built by the Commercial Welding Works, of Lynwood, Calif. The body is welded throughout, including the frame and the top and side covering, the latter being composed of light-gauge sheet metal which, with its smooth, welded joints and a coat of bright paint, makes the finished job very attractive.

THE field kitchen for Tom Mix's Circus was built by Sammons & Son, of Compton, Calif. This "rolling kitchen" is an all-welded job, from the frame of the truck itself to the frame and shell of the body. It is one of about seventy similar ones recently completed for Tom Mix for the current circus season, which opened in Compton, the circus winter quarters, on March 6th.

■

AT THE right is shown a stream-line gasoline truck tank of 1500 gallons capacity, built recently by the Advance Auto Body Works, of Los Angeles. The tank itself is of 10-gauge metal, has three compartments, and is arc welded throughout. The outer shell, of 20-gauge metal, adds attractiveness, as well as safety and strength. The cab and hood also are "tailor made," adding beauty to the lines of the vehicle. The piping has flanged joints, with the flanges welded to the pipe. The tank is mounted on a Mack chassis.

■

Magnetic Flare and Arc Blow in Welding—II

(Second of Two Articles)

From a paper read before the Cleveland Section, American Welding Society, on March 19, 1935.

■ By ROBERT NOTVEST
Welding Engineer, J. D. Adams Co.

IN THE previous article, we considered only arc flare—that is, disturbances created solely through the influence of magnetic flux. Many difficulties and annoyances also result from arc blow—that is, distortion of the arc caused by the turbulence of hot gases.

In order to understand the causes of arc blow and to find ways or means to eliminate this condition or hold it down to the irreducible minimum, we must first consider briefly the physical and chemical nature of the metallic welding arc.

Arc Maintains Itself Through Ionization

In "striking" a welding arc, the iron electrode must actually touch the work in order to complete the electric circuit. The low open-circuit voltage of the average welding generator (65 to 95 volts d.c.) is simply not enough to bridge the smallest air gap, even if only 1/64 in. long. As soon, however, as work and electrode touch, the generator is short-circuited, a greatly increased volume of current flows, through contact resistance considerable heat is developed almost instantly at the point of contact, and naturally, since the electrode end represents a smaller area than the work, it heats up and becomes incandescent far quicker than the larger mass of the parent metal which is to be welded. Now if the electrode, which normally is the negative pole or cathode, is only slightly withdrawn, this incandescent or glowing electrode end shoots off free electrons, which ionize the air gap, enabling the electric arc to continue to carry current across the gap.

All substances which are conductors of electricity have this ability to emit free electrons when heated and, as experiments have proved, more so the higher the melting point of their respective oxides. These electrons—the smallest possible particles of electricity—are ejected from the glowing cathode spot at extremely high velocity. They collide with and shatter gas molecules in their path, thereby releasing additional free electrons which are also violently attracted towards the positive pole or anode. While part of these shattered molecules reunite themselves, nevertheless a tremendous amount of negative particles of electricity bombards the anode and this impact kinetic energy is changed into heat, ultimately forming the pool of molten metal on the work.

These electrons are the smallest particles of all matter and their mass is very small, but their speed may reach 1/3 to 1/2 of that of light (186,000 miles per second). The impact on the anode is, therefore, terrific and accounts for anode temperatures from 2600° up to 4000° C.

The shattering of molecules in the arc gap, as well as the impact upon the molecules of the metal on the anode and the resulting liberation of their negative charges, the electrons, create mass particles or atoms with a residual positive charge, the so-called ions. The mass of an ion is considerable larger than that of an electron; therefore, since in an electrostatic field the propelling force is equal, their speed or velocity towards the cathode is very much slower, so the impact is less, and it follows that less heat is developed on the cathode. Of the total heat energy, 70% to 75% is liberated at the anode and the remainder at the cathode.

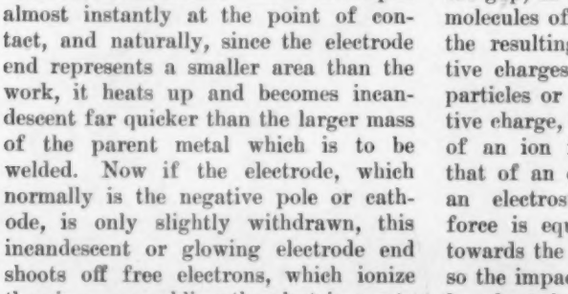


Fig. 9. Deposited Weld Metal and Corresponding Oscillograms.

(A polished strip of mild steel, 4 in. wide and ¼ in. thick, was run under a stationary automatic welding head at a rate of speed in excess of 100 in. per minute. A $\frac{5}{32}$-in.-diameter mild-steel electrode was used, with 150 amperes and slightly more than 20 volts across the arc.)

Glowing Cathode Spot Required to Maintain Arc

Thus it is evident that for the continued existence or uninterrupted maintenance of any welding arc it is necessary that there be an incandescent or glowing spot on the cathode which ejects free electrons. The prerequisite for the conductance of current across an air gap (a non-conductor) is sufficient ionization which can be influenced materially through gases existing or purposely liberated near the arc zone or through coating materials on the electrodes having a high thermionic emission effect—that is, the ability to eject free electrons at relatively low temperatures.

The metallic arc demands a definite value of ignition voltage, depending upon the particular condition at hand. Once the arc is "struck," considerably less potential is required to maintain and stabilize the arc; and since ionization has now increased, the conductance of the air gap is increased or, in other words, its resistance to the passage of current has decreased. Ionization of an air gap increases with greater liberation of heat which, of course, means a greater amount of current flowing; therefore, if the air-gap distance remains constant but if the current increases, less potential should be required to maintain the arc. This seems to be contrary to Ohm's law, but can be readily explained by pointing to the fact that the resistance of the air gap has been materially lowered under such conditions.

With shielded-arc electrodes, there occurs not only a transfer of non-metallic minerals across the arc gap, either in a molten or vapor form, but also some turbulence and ionization or de-ionization effects created by the large amount of suddenly developed hot gases. Hot gases in rapid motion are extremely active chemically, and these help to sustain the arc. In fact, it has been shown in experiments by Doan and Myer, reported in the September, 1932, issue of *Electrical Engineering*, that in a pure gas such as argon an arc can be established and maintained only with diffi-

culty if at all, but the presence of chemically active gases such as nitrogen and hydrogen, even if only in traces, allows the arc to be established very readily.

Practically every passage of a drop of molten metal across the welding arc short-circuits the source of the current, and under an actual welding operation this may take place from 500 to 1000 times per minute. When a drop passes across the gap and, for a very short instant of time, short-circuits the welding machine, the arc voltage drops to a fraction of its normal value, the current flow is tripled or quadrupled, the arc is actually extinguished, and the welding machine must be able, after the interruption of the short circuit, to build up normal voltage extremely fast in order to provide the high potential necessary for the re-ignition of the arc.

Considerable Electrode Metal Passes Through Arc as Vapor

It is an incontrovertible fact that in the usual arc-welding operation, from 5% to 50% of the electrode material ultimately deposited as fusion metal is transferred across the arc in vapor form. Fig. 9 shows the results of a method developed by Doan and Weed, enabling the separation and recording of each successive deposit of fusion metal, and described in a paper at the fall meeting of the American Welding Society in Buffalo, on Oct. 4, 1932. The metal strip was run in synchronism with an oscillograph, giving a continuous and chronological record of the character of the deposit, where each form retained its identity and can be readily recognized.

These experiments corroborate the fact that liquid globules are the chief form of metal transfer, although some metal is transferred as vapor and mist. Some of the deposited drops plainly show cavities caused by the escape of dissolved gases before solidification took place. Since bare wire was used, most of the metal vapor was oxidized before deposition and appeared on the strip as a red powder of Fe_2O_3. A close correspondence can be seen between the individual types of deposit and the individual features of current and voltage waves on the corresponding oscillograms, and it is especially noticeable that the size of the current disturbance on the oscillograph film checks very closely with the size of the globule deposited on the moving mild-steel strip.

While these tests were made with bare wire, slightly different results should be obtained under shielded-arc conditions, since a much greater arc length would be used and the molten globules would not be able to bridge the arc gap, and therefore we would not have the very pronounced current peaks and the voltage zeros that we obtain with bare or light-coated wire.

The danger under shielded-arc conditions occurs when a "speed hound" exceeds the optimum ampere point of an electrode, so that more metal is transferred across the gap in vapor form instead of in molten globules, which introduces trouble all of its own.

Arc Has Higher Temperature Than Steel Furnace

It cannot be repeated too often that in using the electric arc to form fusion metal, which is essentially nothing but a special grade of cast steel, we attempt to produce at highly elevated temperatures (2500° to 4000° C.) what the steel foundry does at 1700° to 2000°.

In the electric furnace, there is usually a melting and refining period of 3 to 4 hours with a subsequent degasification in the ladle by means of ferro-

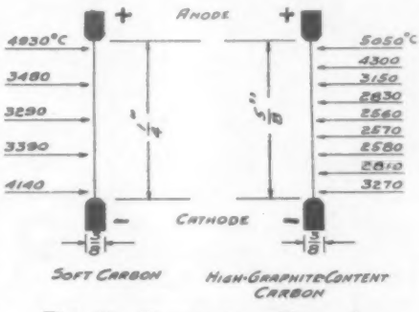


Fig. 10. Temperature Chart of a Carbon Arc.

manganese or ferrosilicon, and only after complete reaction is the molten metal poured into a dry sand mold. In arc welding, the entire metallurgical cycle from solid rod to molten globules to fusion metal congealed into place, requires only from 5 to 20 seconds at the utmost; naturally, under the chilling effect of the large mass of the parent metal it is highly desirable to hold the solute gas content of the liquid fusion metal down to the minimum.

In usual steel-mill practice, it is only in rare instances that a temperature of 2000° C. is exceeded. Therefore, many engineers and metallurgists well acquainted with the iron-carbon equilibrium diagram up to a temperature range of about 1800° C., fail to appreciate that in arc welding we heat metal up to its boiling point, or even slightly beyond under certain conditions. Volatilization of liquid iron begins slightly above 2500° C., and above 2640° C. a condition exists where the superheated fusion metal consists of a liquid iron-carbon alloy saturated with iron-carbon vapors. All this influences not only arc voltage, melting efficiency or deposition rate, but also the density and physical properties of the resulting fusion metal through loss by volatilization of essential alloying ingredients.

On any given welding job for any given electrode, there exists an optimum point of current flow and, therefore, heat liberation in the arc zone, which governs melting efficiency or deposition rate. Heat liberation in the arc zone for a given welding-current flow can be greatly influenced by such factors as the nature and the areo-dynamic state of the surrounding atmosphere, the strength and distribution of the magnetic field, the metallurgical composition of the electrode, and the nature and the amount of gases evolved from the molten metal as well as from the coating ingredients.

Coating Ingredients Have Effect on Optimum Deposit Rate

The practical deposition rate of a shielded-arc electrode is mainly governed by the resistance conditions of the arc gap, and this in turn depends largely upon the thermionic emission effect of the coating ingredients. In a number of instances it is possible to increase the welding speed of a shielded-arc electrode by using straight polarity to the detriment of the physical properties of the resulting fusion metal; since under such conditions the arc action is wild, too much metal goes across in vapor form, causing thereby high splatter losses, and the liquid fusion metal cannnot be properly de-gasified. Most electrode manufacturers have, by careful experimentation, determined under what conditions of polarity their electrodes will deposit fusion metal of optimum physical properties, and such instructions should not be lightly disregarded.

In arc welding, speed is not everything. For any given welding operation there exists a best compromise between metallurgical composition and heat-dissipating capacity of the work, the welding characteristics of the electrode, and the conditions and specific technique under which the electrode must be applied in order to deposit in an efficient manner strong, dense and ductile fusion metal with minimum injury to adjacent zones of the parent metal.

The controversial question, whether straight or reversed polarity should be used for maximum results, assumes an added importance through the decided invasion of 60-cycle-transformer and 180- and 240-cycle rotating types of a.c. arc-welding machines. With a.c. welding, the electrode becomes alternately cathode and anode with each reversal of current, and certain types of shielded-arc electrodes which work splendidly on d.c. produce only inferior results when used with a.c. To better understand the cause of this, let us consider what numerous physicists have proved, that the voltage drop across the arc, as indicated by the various temper-

ature zones in Fig. 10, is not uniform; on the contrary, the maximum potential drop lies close to both anode and cathode, whereas in the gaseous column of the arc core the resistance and, therefore, voltage drop remains fairly uniform.

Stability Is Promoted by Steep Potential Gradient at Cathode

We have previously shown that the incandescent cathode spot is indispensable for the continued existence of an electric arc. It has been experimentally proved that the steeper the voltage drop or potential gradient in the gaseous layer next to the surface of the cathode, the smoother the welding arc, and under such conditions maximum arc stability will be attained. This steep potential gradient at the cathode accelerates the velocity of the ejected electrons, thereby increasing impact ionization; it also gives additional impetus to the positive ions (gas atoms with a positive charge) so that they can in turn through their bombardment energy ($\frac{1}{2}$ mass $\times$ velocity^2) retain the cathode spot in its incandescent state. Conrady and Mueller have made some very interesting experiments, shown in the following illustrations.

With very heavy current and a very short arc, the negative arc flame may reach clear across the arc gap and actually touch the anode, any light phenomena from which are thereby completely suppressed, as shown in Fig. 11(a). It is possible that this effect takes place when in a vacuum tube the negative glow discharge reaches the anode, then the potential drop increases to excessive values, permitting an increase in current flow.

In a carbon arc, the temperature of the anode is between 4500° to 5000° C., depending on whether the electrode contains more carbon or graphite. It can be assumed that the maximum temperature reached represents the boiling or volatilization point of the material used. If the arc is maintained under pressure, increases occur in the overall arc voltage, anode potential gradient, and anode temperature, whereas under partial or complete vacuum a corresponding decrease takes place in all three of these values.

The practical application of this high-faluting theory is that if some "speed hound," when welding thin-gauge metal with the carbon pencil, uses too much current, he actually cannot get higher welding speed, but simply raises the fusion metal to the boiling point and, therefore, gets porous welds.

During welding with the metallic arc, the anode temperature under ordinary conditions will closely reach the boiling point of whatever metal is involved, and the temperature of the cathode will always be lower and can be modified only by the thermionic emission effect of the coating materials.

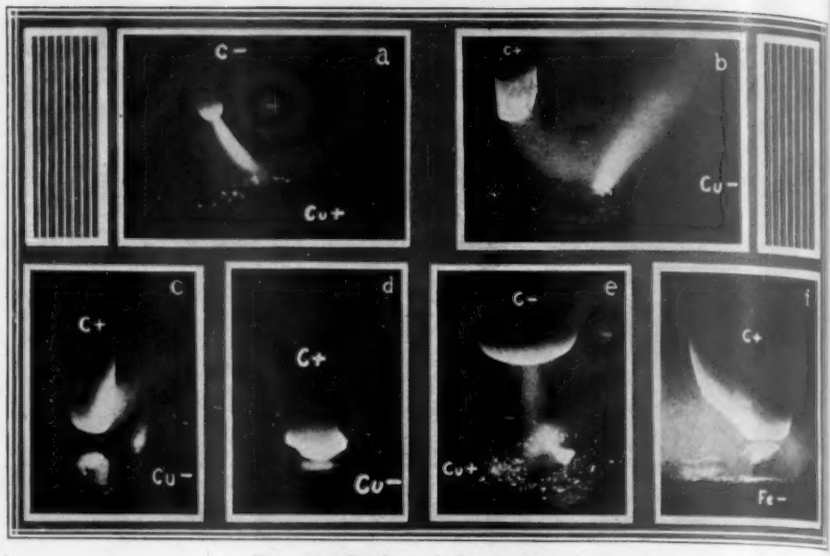


Fig. 11. Studies of the Carbon Arc.

(*a:* The positive arc flame is suppressed by the negative flame by holding a very short arc with a heavy current. *b:* The small incandescent cathode spot is clearly visible, and the arc is highly stable. *c:* Here the cathode is a large pool of molten copper, resulting in an erratic and unstable arc. *d:* Using reversed polarity, the tip of the carbon electrode can be immersed in molten copper, without extinguishing the arc. *e:* (× 10) On straight polarity, the positive ions create a drag as they are expelled from the copper anode, thus drawing the molten copper upward and forming a cone. *f:* (× 10) Under reversed polarity, with a molten pool of iron as the cathode, a cone of molten iron gradually builds up toward the anode.)

Fig. 11(b), which clearly shows both negative as well as positive arc flames, was made with a positive carbon pencil against a cold copper plate. The small incandescent cathode spot can be seen very plainly. In other words, the arc can be maintained with tremendous heat liberation on the anode and very much less on the cathode, which is one reason why high-carbon steel with a low melting point (the temperature of the anode will reach the boiling point of whatever metal is used) can be arc welded after a fashion with low current and reversed polarity.

Agitation of Cathode Spot Makes Arc Erratic

While the arc shown in Fig. 11(b) burnt smoothly with high stability because the incandescent cathode spot was definitely orientated, in Fig. 11(c) is shown the same arc with the same amount of current flowing, but this time through preheating and suitable mounting of the copper plate upon asbestos board the arc is played upon a large pool of molten copper which is in a state of continuous agitation through the rapid conduction of the heat towards the solid metal. The magnetic flux set up by the arc itself now rotates the cathode spot at considerable speed and, of course, the arc is highly erratic and unstable; again, the incandescent cathode spot plainly emits the negative arc flame.

From this it can be readily seen why so much arc blow and magnetic flare is encountered when welding with large-diameter shielded-arc electrodes at high current values under reversed polarity near the bottom of a large-size V butt weld. Since such conditions create a considerable pool of liquid fusion metal, the essential cathode spot has the finest opportunity in the world to dance all over the surface of the liquid fusion metal.

Fig. 11(d) shows the maintenance of a carbon arc under extremely disadvantageous conditions. The positive carbon has been immersed into a graphite crucible, containing molten copper, about $\frac{1}{2}$ in. below the surface. The arc continues to burn because volatilization of the carbon (again, anode temperature equals boiling point of material employed) is producing sufficient gas to create an envelope to isolate the carbon with a layer of gas from the molten copper. If the positive carbon is now immersed still deeper so that the liquid negative copper can touch a black (cold) surface of the carbon, the arc is immediately extinguished through short circuit.

If the polarity is reversed, that is, carbon is cathode and molten copper is anode, the experiment cannot be repeated for the obvious reason that the anode temperature (the boiling point of copper) is so low that an insufficient number of positive ions are ejected from its surface, and since the cathode is immersed into the molten copper, the few ejected ions are distributed over a very large area and therefore cannot bring the cathode or a spot thereon to the boiling point so that the essential gas envelope is formed.

The prevalent accepted arc theory assumes that the incandescent cathode spot ejects at very high velocity electrons, which are extremely small particles of electricity having but little mass action, and that from the anode atoms

of gas with a positive charge (particles of tremendously greater mass action) are propelled towards the cathode. Fig. 11(e) shows at 10-diameter magnification how this creates a suction in the liquid pool of copper on the anode, actually forming a cone of molten copper which is supported through this drag of the positive ions against the action of gravity and the opposing blow from the negative arc flame. This is just one indication of what complicated forces are at play to enable us to arc weld overhead with reversed polarity using shielded-arc electrodes of small diameter.

A similar phenomenon is shown in Fig. 11(f), 10 times magnified, between a carbon anode and a molten pool of iron as cathode—that is, under reversed-polarity conditions. There is a pronounced depression on the surface of the liquid iron and, contrary to gravity, a cone of molten iron is growing towards the anode which, if the arc distance is maintained, will in the space of two to three minutes short-circuit and extinguish the arc. This phenomenon cannot be demonstrated under otherwise identical conditions with straight polarity, nor under reversed polarity with an iron electrode playing upon a carbon plate.

Carbon Particles Reduce Negative Arc Flame

Just as certain metallic oxides, especially those of the alkali metals, through a higher thermionic emission effect will substantially increase the negative arc flame, other substances (especially incandescent carbon particles) can materially reduce this effect through an opposing stream of ions flowing from the anode towards the cathode.

If a wire, say, of 0.90% carbon, is used on straight polarity, the arc is extremely wild and erratic, large globules of metal seem to reluctantly hang onto the electrode tip and freeze immediately upon transfer, no penetration is obtained in the parent metal, and there is a tendency to form areas of incomplete fusion. With reversed polarity, conditions are materially improved, although now considerably less current should be used.

It, therefore, must be assumed that electrodes of higher carbon content than 0.20%, when used on straight polarity, eject from the molten pool of fusion metal a sufficiently greater amount of positive ions (mainly carbon monoxide but also some very small incandescent carbon particles) to materially reduce the negative arc blow. That small incandescent carbon particles, carbon in vapor form, and incandescent carbon monoxide atoms, exercise a directional preference in an electrostatic field—that is, exhibit a tendency to wander from the positive towards the negative pole—can best be demonstrated through the example of the d.c. carbon-arc lamp, where the positive carbon always burns twice as fast as the negative and incandescent carbon particles and carbon vapor are actually transferred across the arc and gradually increase the size of the negative carbon.

This directional preference of incandescent carbon particles or carbon vapor in an electrostatic field (the main contributory factor which enables us to deposit fusion metal overhead with small-diameter shielded-arc electrodes under reversed polarity) can be proved by an experiment of intense practical value.

Carbon Electrode With Reverse Polarity Carburizes Plate

Fig. 12 shows at the left, at 100-diameter magnification, the structure near the surface of a 0.35-0.45% carbon plate melted through the application of a ¼-in.-diameter carbon electrode, using about 175 amperes reversed polarity or the carbon as anode. The surface has been carburized to an almost unbelievable degree, a chemical analysis showing a carbon content of 2.5-2.8%.

On the right is shown the structure of the same medium-steel plate, the surface of which has been melted under identical conditions except that now straight polarity was used—that is, the carbon electrode as negative pole or cathode. Here a very little carbon pick-up is shown and the chemical analysis reveals a carbon content of 0.58-0.62%.

Most remarkable is the difference in the transition zone between metal recrystallized through fusion and original parent metal. At the left, where reversed polarity was used for the liquefaction of the surface, there is even a layer of extremely high carbon content, whereas in the second instance under straight polarity the transition is very gradual.

All the phenomena discussed in the foregoing explain why it is easier to do overhead welding with a 0.04-0.06% carbon, about 0.15% manganese electrode using straight polarity, than when using a 0.13-0.18% carbon, 0.40-0.60% manganese electrode of same diameter and with the same current flowing but employing reversed polarity.

In the first instance, the melting point is higher, causing a quicker freezing of the fusion metal, which is essential, as you cannot maintain a large pool of fusion metal overhead. Also, the surface tension of the molten metal is lower, which permits the forces of cohesion to offset to a large extent the opposing gravitational pull. And last but not least, the negative arc stream is larger, assisting the transfer of the metal.

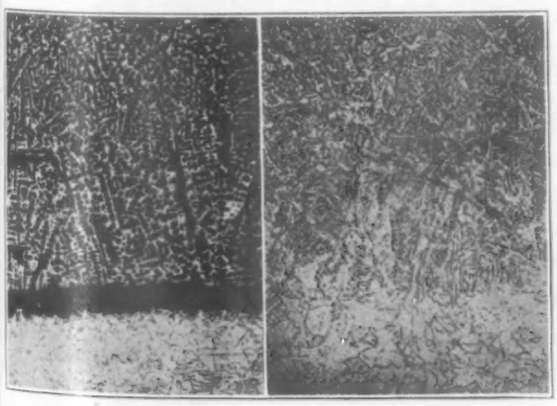


Fig. 12. (× 100) Micrographs Taken Near the Surface of a Mild-Steel Plate, of Material Melted by the Carbon Arc.

(With reversed polarity, the surface is highly carburized, as shown in the view at the left, but with straight polarity very little carbon pick-up is in evidence, as shown in the right-hand view.)

Code on Resistance Welding of Frame Members

A "Code for Resistance Welding of Structural Steel in Building Construction" has been formulated by the Committee on Building Codes of the American Welding Society and published by the Society, whose headquarters are at 33 West 39th St., New York, N. Y. This code recognizes the use of resistance welding "for the multiple shop fabrication of truss-shaped or beam-shaped members for floors and roofs and for the shop fabrication of steel stringers and sheet metal parts of stairs and other similar members." The code covers materials, stresses, design, fabrication and testing. Since such members are fabricated in multiple quantity, they can be subjected to destructive tests as a means of qualifying the resistance welding machines and set-up of the work.

50,000 Francs in Prizes for Carbide Competition

The French manufacturers of calcium carbide and the International Syndicate of Carbide of Calcium, of Geneva, Switzerland, have organized the Second International Competition for inventors and technicians to reward their work in advancing the use of calcium carbide, of acetylene, or of oxyacetylene welding. The competition is now open and will continue until March 1, 1936. A total of 50,000 francs will be awarded, as follows: 1st prize, 25,000 francs; 2nd prize, 15,000 francs; and 3rd and 4th prizes, 5,000 francs each. Rules of the competition may be obtained from the General Secretariat, Office Central de l'Acetylene et de la Soudure Autogene, 32 Boulevard de la Chapelle, Paris, France.

By Welding the Sign Supports, the Girder Strength Is Not Impaired.

Install Signs on Track Structure by Welding

When the Chicago Rapid Transit Lines decided to install signs on their structure at street crossings, it was necessary to find some means of mounting the supporting angle irons which were to hold the huge signs. To rivet, would have required drilling rivet holes in the girders, and thus weakening them. So welding was decided on, the 2x2x¼-in. angles being welded to the inside faces of the top and bottom girder flanges. This leaves the girders unimpaired, so they can develop their full strength.

These angles are fabricated in the shop, and then cut to their correct length at the site of welding. The welding was done by the Western Welding & Boiler Repairing Co., 1432 W. Lake St., Chicago. More than 100 of these signs have already been erected by this method, and 200 more are to be added.

Stuart Plumley Recovering From Severe Illness

Stuart Plumley, a well-known figure in the welding field, has been confined in the Evanston (Ill.) Hospital for several weeks with amoebic dysentery. Though his recovery is very slow, his many friends will be glad to know that he is making progress. Mr. Plumley is an instructor in welding in the Washburne Continuation School in Chicago and is the author of an authoritative textbook on oxyacetylene welding and cutting.

Recommends Continued Code Observance

At a meeting held at the offices of the National Oxygen & Acetylene Association, 75 E. Wacker Drive, Chicago, on June 13th, the Board of Directors of the Association, who also comprise the supervising agency of the oxyacetylene code, recommended that the industry continue their voluntary observance of certain of the code provisions and trade practices. To this end, the Directors passed the following resolution:

"Resolved: That the Board of Directors recommends to the members of this industry the continued observance of the provisions with respect to minimum wages and maximum hours of employees and to the trade practices of the so-called Code of Fair Competition for the Oxyacetylene Industry as approved under the National Industrial Recovery Act."

Building Officials Hold Welding Symposium

The use of welding in steel-frame structures was considered at length in a paper given by F. H. Frankland, technical director, American Institute of Steel Construction, on May 28th, before the 20th annual convention of the Building Officials Conference of America, held in Indianapolis, Ind. The paper was illustrated with slides, and brought forth a great deal of discussion, following which the Conference voted that the chairman appoint a Committee on Welding, to be composed of three active members of the Conference, to investigate welding in the construction of buildings, the present status of welding codes, to contact the American Welding Society for further information concerning matters treated in Mr. Frankland's paper, and to report at the next meeting of the Conference.

100 Trailers Being Built by Minneapolis Job Shop

A contract for 100 double-deck trailers has been awarded The Flour City Oxwelding Co., Minneapolis, Minn., by the King Trailer Corp. of the same city. This type of trailer, known as the "Cattle King," will carry two more cows than a standard railroad cattle car, and at the same time will carry 8 hogs. The company is also making some hog trailers with three decks, having a capacity of 300 hogs. There is also a 4-deck trailer, which will carry 400 sheep.

These trailers are of all-welded construction, and have dual rear wheels in tandem and knee-action. The runway to the lower deck can be used to complete the runway to the upper deck. The sides of the runways are removable and fold against the sides of the trailer while in transit.

Builds Welded Trailers for Travelers Selling Wares

The making of trailers as a supplement to his routine welding work is an important business in keeping him busy, especially in seasons which are ordinarily slack, says Gus Tweed, who operates a welding shop at 3012 Grand River Ave., Detroit, Mich. During the past few months he has made six of these trailers for merchants who travel throughout the country selling floor lamps, kitchen utensils, and other wares. These merchants find it cheaper and more convenient to buy trailers and hitch them to their cars than to buy new trucks.

One of these trailers was an unusually large one and had a box capacity of fifteen tons and required about 93 hours of work to build. The other five were smaller.

"I make most of the smaller trailers by taking laundry trucks and cutting them off at the door and then closing them," says Mr. Tweed. "You get good trailers that way. The box of the larger trailers I construct from old iron."

Unique Portable Acetylene Welding Unit

For welding shop operators and others interested in new ideas, here is something unique and unusual in a portable oxyacetylene welding outfit. It has many points of interest and practical value, and the way it is assembled proves the originality and ingenuity of its designer and builder, L. F. Arnold, head welder

This Double-Deck Welded Trailer Will Carry More Cows Than a Standard Railroad Cattle Car.

in the maintenance and repair shop of the city of San Diego, Calif. Mr. Arnold says that this outfit saves him lots of time in his work and facilitates the handling of the equipment.

As seen in the illustration, the cart, or truck, carries the two gas tanks and has a double hookup for two separate sets of regulators and torches, thus eliminating delays in changing tips for cutting and welding, and of course allowing for the

Mr. Arnold and His Oxyacetylene Outfit.

use of both torches at the same time when and if necessary. Permanent connections for the double set of regulators are built into the frame of the truck, as noted, and are adjustable for forward or backward or any sideways position to suit any size and type of gas tank.

On top is a box of 16-gauge black galvanized iron with separate compartments for tips, wrenches, parts, etc., and with a large section on the left side for the torches when not in use. To the top edges of the box are welded ¾-in. half-round stock, which provides both stiffening and a finished appearance to the box. On the left side of the truck (not seen in the view) is a welding-rod receptacle welded to the frame and made up of pieces of pipe arranged for different kinds and sizes of rods.

Another interesting feature of the outfit is an ingenious electric torch-lighter, consisting of a dry-cell battery, an old Ford auto coil, and a spark plug. This lighter is placed just beneath the regulator hookup at the end. A switch at the bottom of the frame, operated by a button (with hand or foot), produces the lighting spark. The baffle plate shown over the lighting point prevents smoke and fire, when lighting the torch, from smutting up the upper part of the unit.

The entire unit was made up of scrap material and fabricated by means of welding. It is mounted on a truck, the wheels of which were taken from an old Model T Ford car (the front ones being cut down somewhat, as noted), and the frame made up of ¼-in. boiler plate set on edge with 2-in. angle iron welded on each side as stiffeners. The tank support and retaining feature is also of ¼-in. plate welded solidly to the frame, which with a well-designed and all-welded fifth-wheel hookup, and tongue for pulling and steering the outfit about the shop and yard, completes the description of this interesting outfit.

Get "*H. O. T.*" on Welding

■ By H. O T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Size Doesn't Make Good Welding

It seems to me that a lot of people have the idea that to do a good welding job you have to make big, long welds—whereas, as a matter of fact, the best welding job is the one which has the least welding. There is plenty of food for thought in those few words, and I rather expect to get some flash-backs on it. But please bear in mind just what I said and implied. Any welding job must be strong enough. If it is a repair job, it should be made as strong as the original piece. So I ask, why make it stronger? And in manufacturing, good welding starts in the engineering department. Engineers would do well to do some more studying of welding by actual experience doing it and watching good operators at work. Years ago I discovered that the best way to learn any language other than your mother tongue was to have a sleeping dictionary.

* * *

Back on the Farm

A week or so ago I spent the week-end at my sister's farm—and, Mister, did I have fun! The first thing I found when I got there was that they were about to run a water pipe to the barn. Of course, this should have been in for months, but they had been busy plowing and planting, and so on. Well, that was a break for me, 'cause I'm not so hot on this farming racket. So I ties the trailer onto the old flivver and to town I went. Picked up a tank of oxygen and one of acetylene—and off to a junk yard. There I found a whole flock of inch and inch-and-a-half pipe, very cheap. So back I went, and it was not long before I had slapped in the water pipeline. This being done, I looked for new fields to conquer. The pump house was a wooden shack and looked like it might fall over if they got a good wind, and surely with a heavy snow. That was a perfect set-up for me. It wasn't long before I had the frame of a new pump house complete. This I built larger so that it could also be used as a hand-tool house. There was some old galvanized corrugated sheet iron on the place, and this was soon fitted up for the roof and walls and bronze-welded into place. Gosh, what a sturdy and cheap pump house that turned out to be, and very useful, being as they could also keep their hand tools under shelter, and it is absolutely fire-proof—a most important thing on a farm. So I ate a hearty dinner of country ham with all the trimmings, and figured I'd done my share about the place that day.

* * *

Pigs Is Pigs!

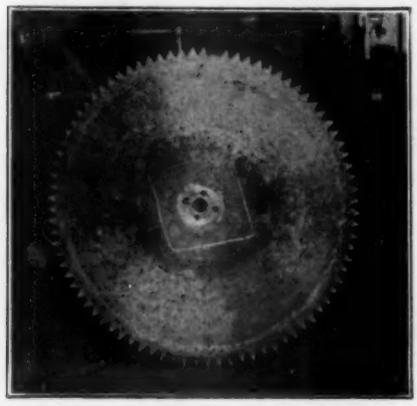
At least, so I'm told. In the peace of the long summer twilight, all hell broke loose out by the barn. It seems as though one of the sows was on one side of a wire fence and her baby pigs on the other. They were being weaned from their mother. Well, old Mrs. Pig decided she wanted to visit her babies and no wire fence was going to stop her. So she went to visiting. Well, we finally got them separated again and safe for the night. Bright and early, I was out the next morning looking over the damage. Had a lot of the pipe left, so I went to building a pig house that old Mrs. Sow could not push over at will, and so that the little fellows could not slip through to her. This is very simple and cheap to build. Of course, every barnyard will present a different problem, but with the welding torch, a cutting attachment, and some 1½-in. pipe, you can do a swell job in short order. The only important thing is to have it well anchored in the ground. This is easy by welding a piece of pipe at the bottom of your upright pipe post to form a "T." Well, to make a long story longer, that's what I did, and by night the job was complete. And how the news spread! By sundown, about 15 farmers had called to see the new pig fence. The kid nephew who lives on the farm will be busy this fall building 'em if I don't miss my guess, from the comments I hear.

* * *

The thought for the month: An organization is but the lengthening shadow of the men that head it.

New Welding Technique for Repairing Circular Saws

What seems to be an entirely new method for welding circular saws has been developed by Messrs. Dreyer and Platt, of The Welding Shop, North Bend, Wash. This method employs a combination of alternating current, oxygen and a fuel gas, with any of various kinds of welding rod. This method has been used to put new eyes in circular saws and to repair cracked ones. No hammering is said to be necessary after welding, and there is no warpage or dishing. About a



This Welded Saw Has Run Nine Months on the Original Arbor.

dozen saws made by this process of repair are in use around the Puget Sound country. Some of these have run about nine months, and it is reported that not one has failed.

Casting Broken in Utah Is Repaired in Denver

A difficult job of gas brazing a water-jacket was recently accomplished by A. W. Smick, partner, U. S. Welding Works, 1325 Market St., Denver, Colo.

This was a 4-cylinder, 150-hp. distillate engine. It had been used for stationary work in a mine. Cooling was accomplished by pumping fresh water through the jackets. The water had been allowed to freeze and had cracked pieces of cast iron as large as 5x9 in. out of the jackets on the tops and sides of all four cylinders.

The blocks and upper half of the crankcase were trucked in all the way from Utah. As they stood over 5 ft. high and weighed 4½ tons, work was done on them as they stood on the truck.

The jackets were veed out with electric grinders and hand chipped at the corners. One block was brazed at a time, the second being preheated while the first was being welded. Preheating was done with oil.

The work took about four hours to each cylinder block; two days for the entire job. The truck, still loaded, left for Utah the end of the second day.

A Welding Engineer's Wife Speaks Her Mind

■ By ONE OF 'EM

Welding Is an Old Craft

As a child I liked to watch my father making wagon tires in his blacksmith shop. He would form iron bars into hoops and weld the ends together. A group of neighbor children would join my sister and myself at the open door of the shop on our way home from school afternoons. We stood there, quietly fascinated, as father heated the black bars of wrought iron into glowing shapes in his little forge, and hammered them into horseshoes upon the anvil. When the horseshoe shape was forged out, there remained only to turn up the heel calks and weld on the toe calks. Then the shoe was hung up with others of its size on a spike driven into a rafter. Some horseshoes were not calked at all. Father looked after the feet of some race-horses stabled in our town. Shoes for these fine animals were never calked; their dainty hoofs had light shoes made of the finest Swedish iron.

Father welded wagon tires, shackles for singletrees, hames and plowshares. He made welded chain, tempered tools for the farmers and more than once tried his hand at ornamental iron work. Father was a welder. Perhaps he didn't weld the same things that modern shops do, but he was the professional welder in our town. His forge and anvil are long overlaid with dust, but the craft of welding lives on.

* * *

He's a Swell Fella, But—

My husband is a nice man. He's good looking, dresses well, and has grand hair. He never kicks about bills, even for those silly folderols we women buy. He shells out cheerfully for party dresses and show tickets and new slippers. He brings a breakfast tray to my bedside when I'm down with a headache. He rides the trolleys when I want the family car to go to a bridge-party, and never squawks when I dash in madly at a late hour, to open a can of beans for his supper.

He likes my relatives better than I do, even the squiffy ones like my Uncle Welch, who chews tobacco untidily, hasn't a bit of sense and won't work. To such orks he sends a year's subscription to the *National Geographic Magazine* for a Christmas present.

This husband of mine admires my hats, never complains about the meals, and doesn't rave when the children keep the radio going for hours. He remembers my birthday, sends my favorite gardenias on wedding anniversaries, and never forgets annually to post a nice, mushy Valentine.

His old-fashioned cocktails are divine, and he broils an excellent steak. He helps the children with their home-work. At parties he is a good master of ceremonies, and has been known to turn in a baritone rendition of "The Man on the Flying Trapeze" that was not bad, not bad.

This marvel among husbands keeps his towels on his own bathroom rack, puts soiled shirts in the hamper, and doesn't leave shaving lather in the washbowl.

In all respects, save one, my husband is a perfect paragon. For that one, though, I may have to leave him; it's that serious.

He won't pick up papers off the lawn!

* * *

Sing and Be Happy

Although I am a Scottish woman, and have inherited the rugged physical outlines of my highland ancestors, temperamentally I am an alien. The Scotch are famed as nickel-nursers, for one thing, and I was never the one to brood over a jitney squandered in a fling. Scottish music, too, leaves me as cold as a bowl of Glasgow oatmeal pudding. The ancestral bag-pipes warm me not at all, but the music of other nations does.

In our large city are many races. A mile in any direction brings me into the midst of large foreign populations. Often in summer I hear the Czechs or the Poles having a good time at their Sunday outings in a grove near us. There is harmonica music, and old and young dance. Here is wine and good cheer aplenty.

The Buckeye Road Hungarians are at once our gayest and saddest national group. The most sparkling czardas played for dancing by their gypsy fiddlers is underlaid with mournfulness, hard to understand in an indomitable people.

Our Russian colony is small, but its gatherings are marked by the chanting of the plaintively melodic folksongs of their homeland.

Mayfield Road houses a snug Italian settlement, with care-free wine-drinking and a flaunting of bright colors and of a swarthy personal beauty that is ageless. Even the children play accordions.

On the edge of downtown is our Harlem. Here song and laughter are spontaneous. Troubles take wing as these people lift their mellow voices in the strangely ecstatic negro music. Grim living never gets these folks down. "Why worry, honey?" is the negro's philosophy. "Arise and shout hallelujah! Dey's always gwine to be clo'es to wash and totin' to do, honey. Let de white folks worry, dey want to. Cullud folks gwine sing!"

Trade Literature

Welding machines, electrodes, and arc-welding accessories and supplies are described and important features pointed out, in new catalogs published by the J. D. Adams Co., Indianapolis, Ind. Included are specifications of Adams d.c. arc welders, and tables of recommended amperages for different types and sizes of Adams electrodes. The data given make it easy for the purchaser to select the electrode best suited for the specific job.

Welding Wire Price Schedule No. 508 was recently published by Williams & Co., Pittsburgh, Pa. In addition to welding wire, this list also covers solder, carbon electrodes, welding plates and paste, brazing alloys, fluxes, electrode holders, goggles, hand shields, helmets, hose, torch lighters, and protective clothing. A number of new welding wires are listed for the first time.

"Bridgeport Bronze Welding Alloys" is the title of a new booklet issued by the Bridgeport Brass Co., 776 E. Main St., Bridgeport, Conn., giving information on bronze welding and describing the various "Bridgeport" rods and giving their strengths, melting points, weights and dimensions. Of particular value to the operator is the procedure given for bronze welding iron and steel.

Welding hoods, made of smoked horsehide, are illustrated and described in a leaflet issued by the E. D. Bullard Co., 275 Eighth St., San Francisco, Calif. In one style, the hood is held away from the body by a light-weight head frame. Another style is furnished without the frame, and is recommended for working in close quarters.

The framing of beams into girders to obtain continuity, is the subject of Plate 50, in "Studies in Structural Arc Welding," relating to arc-welded tier buildings. Several designs are shown and calculations given. Copies may be obtained from The Lincoln Electric Co., Cleveland, Ohio.

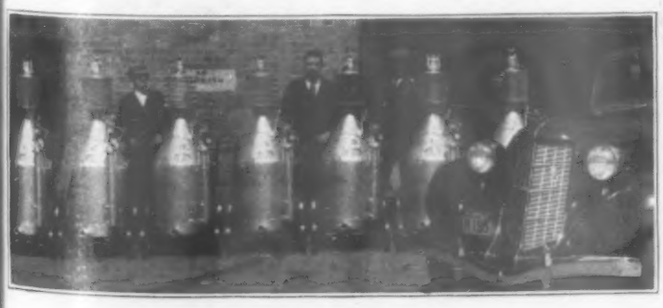
Their catalog of welding and cutting equipment has recently been revised by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill. It lists welding and cutting units, as well as individual torches, also regulators and other accessories and supplies.

A portable spot welder, of 7 kva. capacity and weighing but 80 lb., is described in a folder recently published by the Fassler Welding Machine Co., 424 Stormfeltz-Loveley Building, Detroit, Mich.

Commercial News

Portable Generators Add to Acetylene Supply

Although already served by three stationary acetylene generators, the Connorsville, Ind., plant of the Auburn Automobile Co. recently obtained seven 25-P Sight Feed generators for special work and maintenance, and for departments operating under an unusually heavy schedule. Each of the new generators is mounted on a 4-wheel truck and can be transported from one part of the plant to another, acting much in the same manner as emergency squads. This makes it possible for the company to extend the use of generated acetylene, to do special jobs without having to move them to the regular production line, and adds just that much reserve capacity to handle peak demands.



Auburn Motor Company Adds Portable Acetylene Generators.

Maker of A. C. Welders Increases Space

The Willweld Manufacturing Co., 1501 South 15th St., Omaha, Nebr. has doubled their space, to keep up with demands for their a.c. welder. Don Dayton, for some time with The Linde Air Products Co., has been made sales manager. The president of the company is Don Carroll. Jack Dempsey is secretary and treasurer, and "Heine" Schneiderwind is general manager. Mr. Schneiderwind has just returned from a three weeks' trip through the north and east and reports the establishment of several jobber dealers.

Appointed General Sales Manager for Harnischfeger

Charles W. Daniels has been appointed general sales manager of the Harnischfeger Corp., Milwaukee, Wis. For several years Mr. Daniels was in the Harnischfeger New York office, and more recently was in charge of the Philadelphia

CHARLES W. DANIELS

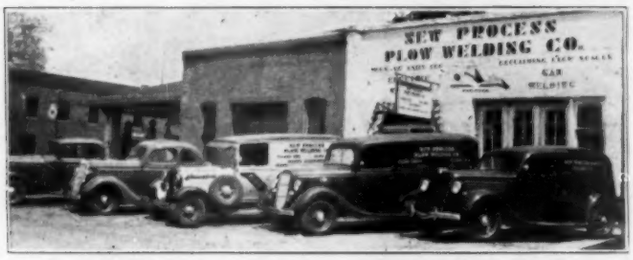
office, where he is being succeeded by L. M. Stout. Mr. Daniels will assume active charge of the sales for the various manufacturing divisions.

Welding and Cutting Show Held in Erie, Pa.

Demonstrations in oxyacetylene and electric welding and metal spraying were given by welding specialists of the Air Reduction Sales Co. at a welding and cutting show held on the night of June 4th, at the Union Iron Works plant, 13th and Raspberry Sts., Erie, Pa. The demonstrations were accompanied by a running explanatory lecture over a voice amplifier. After the program, an open forum was held and questions answered and practical instructions given. The show was attended by about 800 executives and welders from local plants.

Maker of Plow Reclaiming Units Adds New Furnace

The business of the New Process Plow Welding Co., Perry, Iowa, has grown to the place where they are now using a fleet



Fleet of Cars Used by New Process Plow Welding Company.

of five cars, three of these being trucks for delivery and pick-up. The company has also ordered a natural-gas furnace to be used in the heating of the steel that goes into the making of reclaiming units. This new furnace will give a sustained high heat over a long period of time, making it easier to turn out a uniform product.

Tenney Recovers From Neck Injury

G. E. Tenney, Chicago district manager of The Lincoln Electric Co., is back on the job after having spent many months in a hospital recuperating from some fractured and dislocated neck vertebrae suffered when he was thrown from a horse on Sept. 9th, last. Tenney's recovery is not yet complete, as he has to wear a cast part of the time, but he expects before long to be his "old self" again.

The Universal Power Corp., Cleveland, Ohio, have appointed as representatives, O. C. Underwood, of 11249 S. Hermosa Ave., Chicago, who is widely known in the industrial and railway fields in the Chicago area, and W. S. Murphey, of Charlotte, N. C., who will have charge of sales in both of the Carolinas.

A. J. O'Leary has been promoted to the position of assistant to the general manager of sales at the Lukens Steel Co., Coatesville, Pa. Prior to joining the Lukens organization in 1916, he was with the Pennsylvania Railroad and the Alan Wood Steel Co.

Gus Mayer, assistant secretary and assistant treasurer of the Commercial Acetylene Supply Co., 40 Rector St., New York, N. Y., died on May 31st. He had been actively connected with the Commercial Acetylene company for the past 18 years.

Welding demonstrations by factory experts from the Lincoln factory were given at the Fuchs Equipment Co., Omaha, Nebr., June 20th and 21st. This was well attended by out-of-town users of welders.

The Buffalo, N. Y., office of the Republic Steel Corp. has been removed from 475 Abbott Road to 1020 Liberty Bank Building. Thos. B. Davies continues in charge as district sales manager.

Earl Randall has joined the Tri-City Welding Works, Moline, Ill., and is representing a line of spot welders, resistance-welding timers and oxyacetylene welding equipment.

The Aladdin Rod & Flux Manufacturing Co. has announced the removal of its office from Des Moines, Iowa, to Grand Rapids, Mich., P.O. Box 935, Madison Sq. Station.

Bryant Machinery & Engineering Co., Chicago, Ill., has appointed the W. G. Nichol Co., 711 W. Michigan St., Milwaukee, as exclusive agent in the Milwaukee territory.

W. H. Hobart, of Hobart Bros., Troy, Ohio, with his family, left June 8th on the *S. S. Rex* for a 60-day European trip, during which he will combine business with pleasure.

Col. R. H. Morse, of Fairbanks, Morse & Co., Beloit, Wis., has been elected a director of Compressed Industrial Gases, Inc., 221 N. La Salle St., Chicago, Ill.

Revere Copper and Brass Incorporated has announced the removal of its Pittsburgh, Pa., office to 1028 Gulf Building. J. F. Croasdale is district manager.

Harrisburg Steel Corp. is the new corporate name of what was formerly the Harrisburg Pipe & Pipe Bending Corp., of Harrisburg, Pa.

Notes From the Field

With the completion of a new addition, 40x50 ft., to their former plant, the Flour City Oxwelding Co., of Minneapolis, Minn., double their plant floor space. G. V. Watson is proprietor of the company. The year 1934 was by a wide margin the most successful of the company's 16 years of business, Mr. Watson reports, it being 40% over the next best year. The new plant addition contains an overhead traveling crane and is equipped with two overhead-type doors with 14x14-ft. openings. The new addition will house the production and manufacturing end of the business and will be in charge of Carl Nordgren, while the old shop will handle the job-welding business and will remain in charge of L. L. LeJune.

Inquiries have been received in the Pittsburgh, Pa., market from the American Oil Co. for eight all-welded steel tank barges for the transportation of petroleum products. Plans are now being drawn for storage equipment to be installed at the American Oil Co.'s recently acquired siding on the left bank of the Monongahela river at Hays, Pa. According to preliminary plans there will be seven vertical steel tanks, with a total capacity of 32,500 barrels, and 19 horizontal tanks with a capacity of 20,000 gallons. It was said that plans for the welded barges are nearing completion; they will be 192 ft. long, 35 ft. wide and 8 ft. deep, with a capacity of 8,000 barrels each.

Quite a bit of time and money was saved for the Kingston Sand & Gravel Co. a few weeks ago, when the Superior Welding Co., of 331 Knoxville Ave., Peoria, Ill., welded a 16-in. manganese-steel pump casing, which was mounted in a stationary position on a dredge boat. About 150 lb. of manganese rod was used. A large cutter head and drive shaft was also repaired, about 125 lb. of rods being used to build up the cutter head and weld on new teeth. The bearings in the drive shaft were built up with shielded-arc electrodes. This shaft was then turned down in a lathe.

The McClintic-Marshall Corp., of Pittsburgh, Pa., are building 18 welded tanks of 50,000 gallons capacity each, for the American Barge Line, to be used in carrying gasoline from Texas and Louisiana by river to the Pittsburgh market. These tanks, which are 14½ ft. in diameter and 40 ft. high, are to be mounted in groups of three on six barges, which are of welded construction throughout, being made of plates 5/16 in. thick. The tanks and barges are being fabricated at the Leetsdale works and will be ready for delivery about the middle of July.

O. W. Oppenheimer, president of the Pittsburgh Steel Drum Co., Pittsburgh, Pa., recently announced the abandonment of the Apollo, Pa., plant, where 79 employees had been on strike for a number of weeks. Mr. Oppenheimer said the factory would be moved to Butler, Pa., to

Part of the equipment fleet operated by Massachusetts Welding Company, and (insert) the genial and dynamic Frank O'Rourke, who started the business and manages it today.

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Electric and Acetylene Welding

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BOSTON, MASS.

Radiators Re-Cored and Repaired
Ship Work and Marine Boilers
Specialists in Thawing Frozen Water Lines

March 26, 1935.

The American Brass Company
Waterbury
Connecticut.

Gentlemen:

During the past 15 years, our welding business has increased tremendously. We attribute our growth to these three facts: (1) Our workmen are trained to produce A-1 work. (2) We use only the best grade of stock. (3) Our prices are fair.

The use of good stock is one of our fundamental policies. Good stock builds Good Will for our shop. Therefore we recommend genuine Tobin Bronze and use it exclusively as we have since our business was started 15 years ago.

Very truly yours,
MASSACHUSETTS WELDING CO.
Frank O'Rourke

From a two-man shop operating one truck to the largest business of its kind in the state of Massachusetts . . . in the short space of fifteen years! That is the achievement of the Massachusetts Welding Company of Boston under the management of Mr. Frank O'Rourke.

During his years in the welding business, Mr. O'Rourke has always used good stock . . . Tobin Bronze. Read his letter, reproduced here. It tells you what he thinks of the original low melting point bronze rod.

Don't gamble with an unproved rod. Ask for and get *genuine* TOBIN BRONZE. It carries the name stamped every 12 inches in each rod.

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ANACONDA WELDING RODS

obtain larger quarters and better railroad facilities, and that the Apollo factory, where the company has made steel containers for 14 years, would be disposed of. In a statement confirming the move, he ignored the strike, which had been called for higher wages.

The Ted Farris Welding Co. has moved from 1633 W. Main St., Oklahoma City, Okla., to larger quarters at 116 S. Walker, where it will operate as the Ted Farris Co., Inc., with personnel consisting of Ted Farris, president; Carl Guth, of the Guth Welding Works of El Reno, secretary-treasurer; and A. M. Smith, vice-president. Complete machine-shop equipment has been added. The company specializes in the heavier industrial repair work for which both Mr. Farris and Mr. Guth are well known throughout the Middle West.

During the cement pouring on the Evergreen dam at Evergreen, Colo., one of the 4-in. cast-iron flumes at the bottom of the dam cracked. A telephone call was made to C. N. Blanchette, of the Blanchette Welding Co., 608 W. Colfax, Denver, to come and make the repair. Although Denver is some 30 miles of mountain road from Evergreen, the flume was brazed and pouring resumed on the job five hours after Mr. Blanchette received the call.

A contract for the welding of sub-blowers for the U. S. government was recently awarded the St. Louis Welding Co., 4011 Forest Park Blvd., St. Louis, Mo., according to J. H. Bauman, proprietor. These blowers are standard equipment on all government vessels. There are 36 nozzles to every pipe, each of which must be welded separately. The function of the blower is to remove carbon from the ship's boilers.

Bob Horn, proprietor of the Horn Welding Co., of 1779 Mississippi Ave., St. Louis, Mo., has gone in for modernization in a big way. A new electric welder and two new portable outfits are recent additions to his shop equipment. He recently completed a contract calling for a large variety of construction equipment welding, much of which was rebuilding tractor chains.

The Pittsburgh Welding Corp., 1201 Ridge Ave., Pittsburgh, Pa., has been employing a force of men recently to repair barges that have been damaged in collisions. The company obtained some valuable publicity in the May 27th issue of the *Pittsburgh Press*, which showed the possibilities of welding in the repair of damaged barges, and included four illustrations.

It is reported in the Pittsburgh, Pa., market that one of the largest welded jobs in many years is soon to be let by the Federal Government in connection with the purchase of ¾-in. plate conduit welded lining for use in connection with the construction of the Tygart River Reservoir Dam, near Grafton, W. Va. Considerable tonnage will be involved.

Noble Hall, proprietor of the Guarantee Welding Co., 4146 Olive St., St. Louis, Mo., has been devoting his time to the manufacture of two large experimental electro-plating vats for a Chicago chemical concern. The vats are 30 in. wide, 42 in. long and 72 in. deep. The specifications of one call for a lead lining, while the other will be unlined.

Repairs, welding and brazing on credit, through the Auto Finance Co., 3145 Locust St., is being advertised by Herb & Wally's Welding Shop, 2112 S. Seventh St., St. Louis, Mo. Repairing and welding small tools for the Graner Construction Co. kept the shop busy for the past month—a period which had, in other years, proved very dull.

The Triangle Manufacturing Co., of Los Nietos, Calif., until recently located at 1277 Los Nietos Road, has been moved to 2245 Norwalk Road. The new location affords much larger and better quarters for the ever-increasing business of this concern, which specializes in oil-well-drilling-bit service, hard-facing, and general oil-field welding.

Post cards, with a mimeographed message and sketch, showing means of reinforcing railroad viaduct columns by welding, are being distributed by the Pittsburgh Welding Corp., 1201 Ridge Ave. N. S., Pittsburgh, Pa. This company last winter repaired many such columns where they were reduced by corrosion at street level.

Two complete grease racks were built and welded by the Superior Welding Co., of Peoria, Ill., for Skelly Gas Station No. 1, in that city. These racks measure 40 ft. long, one being narrower than the other. The wider grease rack is used for large trucks and cars, while the narrower rack is used for Austins and other small cars.

The manufacture and repair of tar kettles for roofing contractors is the main business of Marty's Welding Shop, 907 Russell Blvd., St. Louis, Mo. Frank Marty, proprietor, states that he expects a sharp increase in business with the coming of warm weather, and renewed activity in the roofing game.

Joe Moore, for several years head welder for the Baker Ice Machine Co., of Los Angeles, Calif., recently resigned and has opened a welding shop in connection with a refrigeration-engineering service at 3241 Josephine St., in Lynwood, Calif. The new concern will operate under the name of Bowers & Moore.

Denny's Welding Shop, in East Los Angeles, Calif., owned and operated by D. G. Green, was recently moved from the old location at 1284 S. Hicks St. to 4001 East 9th St. Mr. Green has acquired a long-time lease on the new location and contemplates the erection of a new building in the near future.

A profitable business in the welding up of pits and pockets in monel-metal castings has been built up by Earl Dollison, owner of the Dollison Welding Shop, 512 E. 18th St., Kansas City, Mo. He now obtains all the work of this nature from one of Kansas City's prominent brass foundries.

The Ace Ornamental Iron & Welding Works, formerly operating at 5042 Valley Blvd., Los Angeles, Calif., has been moved to 5156 on the same boulevard, where O. D. Burnham, the owner, has built a new shop building, 30x60 ft., with living quarters at the rear of the new building.

The Mission Welding Works, formerly known as "Shorty's" Welding Works, of 542 Mission Road, Los Angeles, Calif., has been moved across the street to No. 559. The shop has not changed management, but has merely changed in name and location. H. E. Brann is proprietor.

The Cockrum Welding Service, 400 W. Avenue 26, Los Angeles, Calif., has been changed in name to Cockrum Co. H. H. Cockrum, proprietor, recently installed new equipment for welding vessels under the A.S.M.E. unfired - pressure - vessel code, and for general steel plate work.

Paul B. Hughes, formerly operating a welding shop at 54th St. and Pacific Blvd., in Huntington Park, Calif., after several weeks of search for a place to open a shop in the Northwest, has returned to Los Angeles and is opening a new shop at 1708 S. Soto St.

Omaha dealers are finding another big use for electric welders of the portable type. Structural-steel workers, where they have a job of any considerable size, are purchasing machines and doing the work themselves. That means the lopping off of another sub-contract.

A chemical tower for the Liquid Carbonic Co., of 3216 Market St., St. Louis, Mo., required 4100 lineal feet of welding. The tower is 100 ft. high and 30 ft. in

A NEW ELECTRODE

SWEDOX

"Blukote"

offers the solution for cast-iron welding

When used with direct current "BLUKOTE" simplifies the welding of CAST IRON, and makes a weld that is easily machined.

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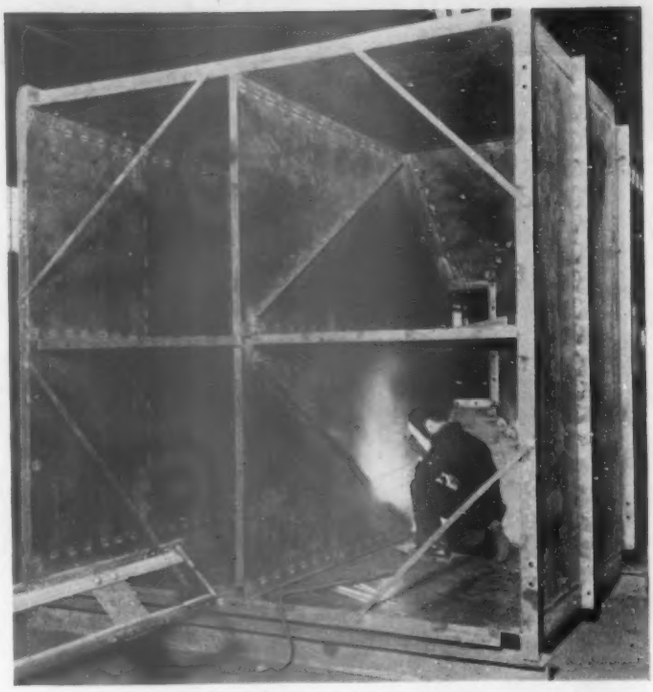
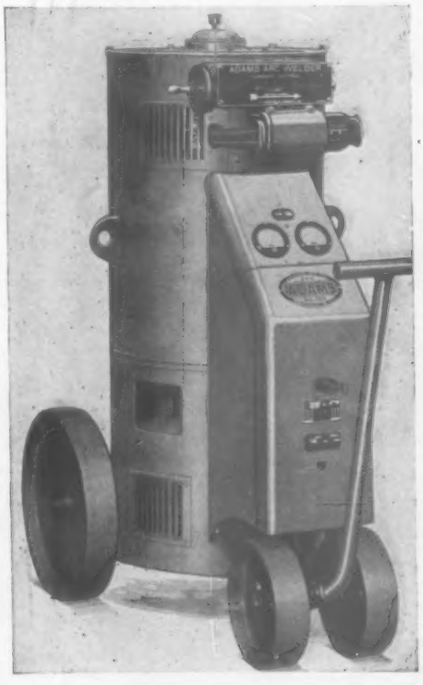


ADAMS TANK-CRAFT ELECTRODES COMBINE STRENGTH WITH SPEED

In the welding of mild steel assemblies where it is desirable to obtain high strength and ductility at a relatively high welding speed use Adams Tank-Craft Electrodes. . . This is a four-compartment aggregate hopper built up of ¼ inch plates and angles on which Tank-Craft Electrodes are used—Hetherington & Berner, Indianapolis, Indiana, manufacturers.



Let Adams arc-welding equipment and electrodes improve your product. The Adams line includes:

Motor-Driven Arc Welders, Vertical Type

Gasoline-Driven Arc Welders

Gas and Slag Shielded Electrodes

Processed and Bare Wire

Adams-Una Automatic Welding Heads

Automatic Welding Wire

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diameter, and the welding was done by the St. Louis Welding Co., 4011 Forest Ave., St. Louis, Mo.

The Larsen Welding Works, of Oceanside, Calif., recently had the bad fortune to wreck their portable welding unit in a traffic accident. Fortunately, no one was injured, and the welding machine has been overhauled and is now functioning again.

The Guarantee Welding Co., 4146 Olive St., St. Louis, Mo., recently received a contract for all the welding work of the local branch of the Singer Sewing Machine Co. Most of this work pertains to remodeling machines now in use.

L. ("Whitie") Dillinger, proprietor of the Whitie Welding Service, 1825 West 213th St., Torrance, Calif., has opened a branch welding shop in the new oil field at Playa Del Rey, near Venice. The location is 7812 Manchester Ave.

A contract has been awarded to the Atlas Construction Co., of Pasadena, Calif., for the reconstruction of the general machine and welding shops for the John C. Fremont High School at 7676 S. San Pedro St., in Los Angeles.

A new welding shop, operated by Lloyd C. Brown, formerly with the Texas Co., was recently opened for business at 2416 East 54th St., in Los Angeles, Calif. Mr. Brown has had wide experience in oil-field and refinery welding.

Welding work on truck chassis and bodies for the Ward Baking Co. and the Grennan Bakeries, both St. Louis concerns, have supplied the Johnson Welding Co., 3913 Cass Ave., St. Louis, Mo., with work for the past three years.

The Carrollton Coal & Sand Co., Carrollton, Ky., are to have constructed for them a sand-digger hull for river operations. The hull will be 130 ft. long, 30 ft. wide and 5½ ft. deep and of welded construction throughout.

An all-pipe oil-field derrick, which required considerable welding and flame cutting in its construction, was recently completed by Wood-Watson, of Seminole, Okla., who now have another one under construction.

The Boulevard Welding Works, formerly operating at 1336 Anaheim Blvd., in Long Beach, Calif., have been moved to new quarters at 1282 on the same boulevard. The shop specializes in marine welding jobs.

A contract has been awarded for the construction of a brewery for the Bakersfield (Calif.) Brewery Co. The plant, which will be a three-story structure of concrete and steel, will cost approximately $19,000.

John W. Buol has purchased the plant of J. G. Hunt & Co., at 1130 W. Broadway, in Long Beach, Calif., and will specialize in general welding and the construction of all-welded steel bodies and trailers.

H. R. Nevius, owner of a welding and blacksmith shop at 120 S. Granada, El Monte, Calif., is completing plans for the erection of a 40x60-ft. shop building on a vacant lot just south of his present location.

Do You Know Where These Men Are?

FRANK M. ALLAN, SR.—Has not been heard from for about 10 years. One time connected with the Wilson Welding Co. of New York City and was sales representative for several companies. During the War, he welded the cracked cylinder heads of the *Deutschland*. Anyone knowing his whereabouts in recent years will please communicate with his son, Frank M. Allan, Jr., 205 East 42nd St., New York, N. Y.

* * *

RALPH H. KEELEY.—Also known as Ralph Hunter. Left his place of business in Lincoln, Nebr., on March 27th, traveling east in '26 Model ½-ton Ford truck, license No. 2C-693 (Nebr. '35), and 2-wheel trailer (license No. L-9) carrying welding machine. Believed to be on way to Ohio steel-mill district. His wife is anxious to hear from him. Anyone knowing his whereabouts will please convey this information to him, or write Mrs. Keeley, at 635 South 9th St., Lincoln, Neb.

The Allen Motor Shop, at 1448 W. Main St., Compton, Calif., recently added electric welding to their service. A motor-driven 300-ampere machine was installed for general job shop repair work.

The Northern Gas Co., furnishing natural gas to Omaha, Nebr., has added an electric welder to its equipment and now does all its own repair work.

J. A. Nolan recently opened a small job shop welding service at 730 E. Manchester Ave., Los Angeles, Calif. He was formerly associated with the C. M. & S. P. Railway as welder and boilermaker.

A standing order has been given the Superior Welding Co., at 331 Knoxville Ave., Peoria, Ill., for the repair of a number of all-welded seed tanks at the Commercial Solvents Peoria plant.

Plans calling for a large amount of welding are being completed by the Golden West Brewing Co., of Oakland, Calif., for the construction of a brewing plant in San Gabriel, Calif.

F. A. Hovey, for eleven years master mechanic for the city of Ithaca, N. Y., has opened a job-welding shop in Fredericksburg, Va., equipped for both arc and oxyacetylene welding.

The Gleason School of Welding, Lansing, Mich., has moved from 118 W. Washtenau to 311 S. Capitol, according to an announcement from George Gleason, proprietor.

The U. S. Auto Body Co., 3914 Washington Ave., St. Louis, makes a business of rebuilding wrecked cars. The welding of frames and chassis keeps two welders busy continuously.

The Omaha Steel Works, Omaha, Nebr., has obtained a contract involving 17,000 ft. of railing on a bridge job in Arkansas. A portable electric machine will be used.

The Harris Welding Shop, E. Main St., Fremont, Ohio, has found it necessary to expand the shop facilities by tripling the floor space.

Wallace Henry, formerly of the Globe Machinery & Supply Co., Des Moines, Iowa, has been appointed sales manager of Tatro Brothers, Inc., Decorah, Iowa.

The Y. M. C. A., Indianapolis, Ind., started an arc-welding course around the first of June. Mr. Miller, of the Sutton-Garten Co., is the instructor.

The Metal Spraying Corp., of Milwaukee, Wis., has moved its custom shop from 3132 W. Garfield Ave. to 3610 W. Pierce St.

The Omaha Machinery Co. has added a 100-ampere welder to their equipment. This will be used mostly in truck-repair work.